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A Comparison of the Total Factor Productivity and Total Cost Performance of Canadian and U.S. Industries

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The findings of this paper are the sole responsibility of the authors.

Table of Contents

Acknowledgments	vii
Foreword	ix
Abstract	xi
Introduction	1
Analytical Framework	3
What Is Productivity?	3
Net Output (Value-Added) Versus Gross Output Measures	4
Output, TFP, and Labour Productivity at the Industry Level	6
Output Price, TFP, and Input Costs at the Industry Level	7
TFP, Technical Progress, Scale Economies, and Market Power	8
An Overview of Productivity and Cost Trends in Canada	9
Trends in Sectoral Outputs and TFP	10
Unit Costs, Input Prices, and TFP	12
Trends in Labour Productivity and TFP: An Aggregate Picture	15
Canada-U.S. Manufacturing TFP and Cost Comparisons	17
Trends in TFP	17
Trends in Unit Costs	20
Inputs, TFP, and Output	22
Productivity and Costs in the Nonmanufacturing Industries	28
TFP and Output	28
TFP and Labour Productivity	29
Input Substitution and TFP	31
Costs, Input Prices, and TFP	33
Comparison of Trends in Canada and the United States	34
Farming	36
Mining	39

Construction 41
Utilities 43
Transportation, Storage, and Communications 43
Wholesale and Retail Trade 45
Finance, Insurance, and Real Estate 45
Community, Business, and Personal Services 45
Summary 47

Conclusions 47
Pervasive Output and Productivity Growth Problems 47
Capital Accumulation Not a Major Problem 48
TFP: An Important Determinant of Cost Trends 48
Ability to Adjust Is Important 49
Canada-U.S. Competitiveness 49
Policy Implications 53

A The TFP and Cost Performance of Major Canadian Manufacturing Industries 55

B Input Shares in Total Cost for Canada and the United States 98

Notes 109

List of Tables and Figures 113

Bibliography 119

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Foreword

In *Pulling Together: Productivity, Innovation, and Trade*, the Council noted that productivity growth is the fundamental source of improvements in real wages and real income in the long term. Productivity also plays the major role in the determination of a nation's longer-term cost competitive position.

Labour productivity and labour costs are the usual way to measure how competitive a country is, although total factor productivity and total costs provide a more complete picture. At the industry or sectoral level, these latter measurements can be difficult to derive since they require much more data than is usually available – price and quantity data for all inputs are needed. For this paper, the authors were able to obtain data which completely describe the production process in the Canadian and U.S. manufacturing industries in the 1961-88 period. Data were also obtained for Canadian nonmanufacturing industries.

The findings of this paper present a complete analysis of growth in total factor productivity, input productivities, inputs, input costs, output price, and output. The authors show that Canada experienced a pervasive and dramatic slowdown in both labour and total factor productivity in the post-1973 period in almost all industries. This general productivity slowdown was found to explain a large part of the slowdown in business-sector real GDP growth. The slowdown in total factor productivity was also responsible, in part, for the substantial acceleration in output price (cost) inflation in the post-1973 period. And differences in total factor productivity growth across industries mainly determined relative industry output price movements, since input prices were generally similar in all industries.

The authors go on to show that the total factor productivity slowdown and total cost acceleration were much more pronounced in Canadian manufacturing than in U.S. manufacturing. Their analysis suggests that part of this difference reflects the slower and weaker Canadian adjustment to the two energy price shocks of the 1970s. The lesson is that flexible and strong responses in input mix to changes in relative input prices are vital for maintaining good productivity growth and keeping cost growth down.

The data presented here are somewhat different than those used in *Pulling Together* because the authors have updated and revised their estimates using the latest data available, including the recent (January 1992) revisions to the U.S. National Accounts.

The authors, Someshwar Rao and Tony Lemprière, were economists on the staff of the Council.

Judith Maxwell
Chairman

Abstract

In this paper we analyse the total factor productivity (TPF) and total unit cost performance of Canadian industries during the period 1961-88. We also compare Canadian developments with trends in the United States. We show that both countries experienced accelerating costs and a pervasive productivity slowdown in the post-1973 period, although the Canadian experience was considerably worse. The pervasive TFP slowdown in Canada played a significant role in the reduction of output and labour productivity growth, and the acceleration of unit total costs and output prices. We also found that insufficient capital accumulation did not play a major role in the slowdown in labour productivity growth. We show that TFP trends largely determined relative price trends across industries, and hence influenced Canada's trading patterns.

Our analysis reveals the importance of flexible responses in input mix to changes in relative input prices. Productivity and cost performance were found to be strongly and positively correlated with the quickness and strength of the response to the two energy price shocks of the 1970s.

We believe the poorer productivity and cost performance of Canada since the early 1970s was offset by the large depreciation of the Canadian dollar vis-à-vis the U.S. currency between 1974 and 1986. But the large appreciation since then, combined with the relatively poor cost trends in Canada, implies that most industries are now not competitive with their U.S. counterparts.

READER'S NOTE

The reader should note that a conventional symbol similar to what is used by Statistics Canada has been used in the tables:

.. figures not available.

Details may not add up to totals because of rounding.

Introduction

Productivity growth is the fundamental source of improvements in a society's living standards and a key determinant of employment growth. Improved productivity leads to improved real incomes. In the postwar period, rapid productivity growth and improvements in living standards went hand in hand with low rates of unemployment and inflation in Canada. The substantial improvements in real incomes, in turn, helped Canadians to strive for a more equitable and just society.

Since 1973, productivity growth has been very sluggish in Canada and other industrialized countries. Consequently, real income growth has been low by postwar standards. In addition, during the 1980s, productivity growth in the Canadian manufacturing sector lagged behind that in the other G-7 countries, worsening the long-term position of the sector vis-à-vis its competitors. Manufacturing accounts for a large part of the traded goods sector, which in turn represents a significant component of Canada's economy. Thus the health of manufacturing is important, and the deterioration in Canada's relative productivity performance could adversely affect Canadian living standards over the long run, through some combination of reductions in employment, real wages, and the terms of trade [see Rao, Tcharkari, and Lemprière 1990].

In other papers [Rao and Lemprière 1992*a*, 1992*b*], we examine the labour productivity and unit labour cost performance of Canadian industries and, in particular, the industries of the manufacturing sector vis-à-vis the other G-7 countries and the newly industrialized countries of Asia during the period 1950-89. In this paper we extend this analysis by examining the total factor productivity (TFP) and total unit cost performance of Canadian manufacturing and nonmanufacturing industries since the early 1960s. We also compare the performance of the manufacturing industries with that of their U.S. competitors. Since we do not have data on total factor productivity and total unit costs for the U.S. nonmanufacturing industries, we compare the performance of these industries in Canada and the United States using labour productivity, unit labour costs, and the value-added deflator.

In short, in this paper we analyse the interrelationships among the trends in input prices, input mix, input productivities, input costs, TFP, total unit costs, outputs, and output prices which have characterized the Canadian manufacturing and nonmanufacturing industries during the period 1961-88. We also compare the Canadian developments with trends in the U.S. industries. In the analysis we answer a number of specific questions:

- Was the post-1973 productivity slowdown in Canada pervasive across industries and across all inputs?

- What were the contributions of the TFP and input growth slowdowns to the slowdown in output across Canadian industrial sectors?

- How much of the input slowdown resulted from a slowdown in capital accumulation?

- What role did capital deepening play in the slowdown of labour productivity?

- What role did a TFP slowdown play in the acceleration of unit cost inflation in the post-1973 period in Canada?

- Can changes in relative output prices across industries and across time be explained in terms of relative changes in TFP?

- Was the Canadian productivity performance during the post-1973 period uniformly poor across all industries in relation to their U.S. counterparts?

- Have there been differences in how industries in the United States and Canada responded to the energy price shocks, and how did this affect their productivity and cost performance?

- How well did the Canadian industries perform in terms of total unit costs vis-à-vis the U.S. industries?

The paper is organized in the following way. First, we present the analytical and conceptual framework of the paper by discussing the relationships among the various measures of productivity and costs. Second, we analyse the overall trends in total factor productivity in the Canadian manufacturing and nonmanufacturing sectors. Third, we examine the total factor productivity and total cost performance of the aggregate Canadian and U.S. manufacturing sector during the period 1961-88 (in Appendix A we focus on the eight major manufacturing industries). Fourth, we discuss the trends in productivity and costs of Canadian nonmanufacturing industries in some detail. We also compare their performance to that of their U.S. counterparts, using data on labour productivity and unit labour costs, because data on TFP and total costs are not available for the U.S. nonmanufacturing industries. In the final section, we summarize our main findings and point out the policy implications of our work.

Analytical Framework

What Is Productivity?

Production is the process whereby labour, accumulated capital assets, natural resources, other intermediate inputs, and knowledge are combined in the provision of goods and services. The concept is not limited to the output of goods by farms, mines, factories, and so on. It also includes the provision of services of all kinds which either add to the value of goods (such as transport and merchandising services) or are directly bought and sold in the market in their own right (such as the services of doctors, teachers, entertainers, etc.).

Productivity measures the efficiency of the production process by relating the outputs (the amount of goods and services produced) to the inputs (the quantity of labour, capital, energy, and other intermediate inputs used). Productivity increases when the same amount of input produces larger quantities of goods and services than before, or when the same amount of output is produced with smaller quantities of inputs.

In practice, measuring changes in productivity is a difficult task because of the problems associated with the definition and measurement of outputs and inputs. For instance, measuring the output of a firm or an industry often involves combining different types of outputs into a single output measure by means of weighting them by their relative importance in the total production of that firm or industry. Similarly, many types of inputs have to be combined into a single input measure by weighting them by their relative importance in the production process. In essence, what are required for weighting purposes are good price measures for the individual component. Obtaining such measurements often proves difficult. In addition, the difficulties of measuring changes in the quality of inputs and outputs, over time, compound the problems of measuring changes in productivity trends.

Because of these measurement difficulties, productivity measures often focus on single input productivities such as labour productivity, capital productivity, energy productivity, and so on. The most commonly used measure is that of labour productivity, calculated either as the output (in constant prices) per person employed or per hour of labour input. The emphasis on labour productivity is hardly surprising given that growth in labour productivity plays a vital role in improving workers' real living standards. However, it is not the best measure of gains in productive efficiency. Indeed, it can be quite misleading if changes in labour productivity are entirely attributed to changes in labour effort. The output produced with a given amount of labour can change for a variety of reasons independent of any changes in labour effort. Alternatively, labour use could fall as relative input-price changes encourage

a shift to other inputs. Output may remain unchanged, but it would be incorrect to assume that efficiency has increased even though output per unit of labour has increased. Thus all changes in labour productivity are not necessarily due to changes in efficiency. Such an assumption could give rise to inappropriate inferences regarding the productive efficiency of an enterprise, industry, or nation.

The appeal of total factor productivity is that it measures the relationship between output and its total factor input (a weighted sum of all measurable inputs), not just an individual input such as labour or capital. Consequently, changes in TFP measure the residual growth in output not accounted for by the growth in factor inputs:

$$\dot{TFP} = \dot{Q} - \sum_{i=1}^{n} \alpha_i \dot{X}_i \qquad (1)$$

where

$\dot{TFP}$ = growth in total factor productivity;

$\dot{Q}$ = growth in gross output;

$\dot{X}_i$ = growth in the i^{th} input; and

α_i = the share of the i^{th} input in the total value of output.

As a residual measure, changes in TFP are therefore influenced, at least in the short term, by changes in a multitude of factors inducing technical progress, the quality of factor inputs, intensity and flexibility of resource use, capacity utilization, quality of management, product mix, scale economies, market imperfections, quality of the work environment, labour-management relations, and so on. Unlike single input productivity measures, changes in TFP are unaffected by the efficient substitution of inputs induced by changes in relative input prices and demand conditions [Rao and Preston 1984]. Thus growth in TFP measures the change in efficiency with which all factors are used in the production process.

Net Output (Value-Added) Versus Gross Output Measures

Productivity measures (partial as well as TFP) can be developed by using either net output (value-added) or gross output data. The choice depends on whether the focus of attention is on a particular industry or the nation as a whole.

Net output is commonly used to estimate productivity changes for two main reasons: a) productivity measures based on value-added do not put as many

demands on data as do measures based on gross output, and b) the appropriate concept of output for a nation, as a whole, is the total production of goods and services available for final consumption and/or for additions to national wealth. This measure of output from the production side of the National Accounts will be equal to the sum of the outputs of all industries net of intermediate inputs (materials, energy, and services). Hence, the net output-based (value-added) measure of productivity will not pose any aggregation problems in terms of double counting. Labour productivity measures can be computed for every industry as value-added per employed person or per hour of work. Total factor productivity can be computed as the ratio of value-added to the weighted sum of labour and capital inputs. The aggregate productivity of the nation is then simply a weighted sum of the productivities of the individual industries.

However, when the focus is on an establishment, firm or industry level, the appropriate concept of output is gross output, not net output, because the intermediate inputs (energy, primary and processed materials, and purchased services) play an important role in the production process. Furthermore, the use of value-added data at this level will bias the estimate of TFP growth upward except in those sectors in which intermediate input content is zero [Rao and Preston 1984; Hulten 1978].[1]

The apparent methodological inconsistency between the industry-level and aggregate measures of total factor productivity was solved by Hulten [1978], Nishimizu and Hulten [1974], Jorgenson [1980], and Rao and Preston [1984], using Hulten's aggregation rule. Hulten established an exact relationship between the aggregate TFP measure and the industry measure:

$$\dot{TFP} = \sum_{i=1}^{n} (Q_i / Y)\, \dot{TFP}_i + \pi \qquad (2)$$

where

$\dot{TFP}$ = aggregate TFP growth (net output based);

Q_i = gross output of the i^{th} sector;

Y = total net output (GDP) of the economy;

$\dot{TFP}_i$ = TFP growth of the i^{th} sector (gross output measure);

n = total number of sectors; and

π = contribution of interindustry shifts in primary inputs and terms of trade changes to aggregate TFP growth.

The first component of equation (2) is the weighted sum of TFP growth rates of the individual industries (sectors). The weights are the ratios of gross

output (Q_i) in each sector to the total net output of the economy (Y). The sum of the weights exceeds unity, since

$$\Sigma Q_i > Y \tag{3}$$

The intuitive rationale for this weighting procedure is straightforward. An increase in TFP at the sector level, in general, supports both final demand and intermediate deliveries. An increase in intermediate deliveries further increases output in sectors using the intermediate good and thus further increases output and final demand. Because of these indirect effects, the total effect of sectoral TFP growth on aggregate TFP growth will be larger than the simple weighted sum of their direct impacts. The weighting scheme in equation (2) reflects this magnifying effect [Jorgenson 1980; Hulten 1978; and Rao and Preston 1984].

The second component of equation (2) represents the contribution of interindustry shifts in primary inputs to aggregate TFP growth.[2]

Output, TFP, and Labour Productivity at the Industry Level

Assuming that the production process of an industrial sector is represented by a constant return-to-scale production function with the usual curvature properties [Rao and Preston 1984], then its gross output function can be represented by:

$$Q_i = F_i\,(K_i, L_i, E_i, M_i, S_i, TFP_i) \tag{4}$$

where

Q = gross output;

K = capital input services;

L = labour input;

E = energy input;

M = material (primary and processed) inputs;

S = service inputs (purchases from service industries);

TFP_i = productive efficiency of the i^{th} industry; and

subscript i denotes the i^{th} sector. Total differentiation of equation (4) yields the following equation for the output growth of the i^{th} sector:

$$\dot{Q}_i = \alpha_L \dot{L}_i + \alpha_K \dot{K}_i + \alpha_E \dot{E}_i + \alpha_M \dot{M}_i + \alpha_S \dot{S}_i + \dot{TFP}_i \qquad (5)$$

where $\dot{Q}_i$ is the output growth of the i^{th} sector, $\dot{L}_i$, $\dot{K}_i$, $\dot{E}_i$, $\dot{M}_i$, and $\dot{S}_i$ are the growth rates of the labour, capital, energy, material, and service inputs of the i^{th} sector, TFP respectively, and TFP is the growth in the productive efficiency (TFP) of the i^{th} sector.

Equation (5) shows that output growth of the i^{th} industry is equal to a weighted sum of the growth rates of inputs plus the growth rate of TFP in that sector. Under the assumption of competitive conditions in factor markets, the weights (α's) in equation (5) will be equal to the share of each in the value of output (cost shares) [Berndt 1980; Hall 1989; Daly and Rao 1986; Caves, Christensen, and Diewert 1982].

By rearranging equation (5) it can be shown that the growth in TFP will be equal to the weighted sum of the growth rates of input productivities:

$$\dot{TFP}_i = \alpha_L (\dot{Q} - \dot{L})_i + \alpha_K (\dot{Q} - \dot{K})_i + \alpha_E (\dot{Q} - \dot{E})_i + \alpha_M (\dot{Q} - \dot{M})_i + \alpha_S (\dot{Q} - \dot{S})_i \qquad (6)$$

It can also be shown that growth in labour productivity depends on growth in total factor productivity:

$$(\dot{Q} - \dot{L})_i = \alpha_K (\dot{K} - \dot{L})_i + \alpha_E (\dot{E} - \dot{L})_i + \alpha_M (\dot{M} - \dot{L})_i + \alpha_S (\dot{S} - \dot{L})_i + \dot{TFP}_i \qquad (7)$$

According to equation (7), changes in labour productivity will be influenced by growth in TFP as well as by changes in the substitution of other inputs for labour. A 1-percentage-point change in TFP, other things being equal, leads to a 1e-percentage-point change in labour productivity.

Output Price, TFP, and Input Costs at the Industry Level

If we assume that input prices are exogenously determined and that firms minimize costs, then the dual of the production function in equation (4), the cost function, can be written as:

$$C_i = g_i (P_{Ki}, P_{Li}, P_{Ei}, P_{Mi}, P_{Si}, TFP_i) \qquad (8)$$

where C_i = total cost of the i^{th} industry, and P_{Ki}, P_{Li}, P_{Ei}, P_{Mi}, and P_{Si} are the prices of the capital, labour, energy, materials, and service inputs in the i^{th} sector, respectively.

By totally differentiating equation (8), and assuming marginal cost pricing (perfect competition), the dual of the output growth equation (5) can be written as:

$$\dot{P}_{Qi} = \alpha_K \dot{P}_{Ki} + \alpha_L \dot{P}_{Li} + \alpha_E \dot{P}_{Ei} + \alpha_M \dot{P}_{Mi} + \alpha_S \dot{P}_{Si} - \dot{TFP}_i \qquad (9)$$

According to this equation, gross output price growth is equal to the weighted sum of the growth rates in input prices less TFP growth. Other things being equal, a 1-percentage-point increase in TFP growth in the i^{th} sector will reduce its output price by 1 percentage point. In other words, trends in relative sector prices should be largely influenced by trends in relative sectoral TFPs, because growth in input prices is expected to be fairly similar across industries.

Since the growth in TFP is a weighted sum of the growth rates in input productivities, equation (6) can be substituted into equation (9) to yield:

$$\dot{P}_{Qi} = \Sigma\alpha_{ji}(\dot{P}_{ji} - \dot{Prod}_{ji}) = \Sigma\alpha_{ji}\dot{c}_{ji} \qquad (10)$$

where

$\dot{c}_j$ = growth,

$\dot{P}_j$ = growth, and

$\dot{Prod}_j$ = growth productivity in the i^{th} sector and, as before, subscript i denotes the i^{th} sector.

Thus output price growth is equal to the weighted sum of the growth rates in input costs (input price growth minus input productivity growth).

TFP, Technical Progress, Scale Economies, and Market Power

As pointed out earlier, TFP growth in the short term will be affected not only by technical progress, but also by other factors such as capacity utilization, managerial efficiency, labour-management relations, work effort, and so on. Over the medium to longer term, improvements in TFP can be taken as a measure of technical progress. But, even in the longer term, the proportional rate of change in TFP will be the same as the upward shift in the production function (downward shift in the cost function) only under conditions of constant returns to scale and marginal cost pricing (perfect competition).

Under the assumptions of nonconstant returns to scale and nonmarginal cost pricing (market power), the rate of growth of total factor productivity

can be decomposed into three components: shifts in the production function/cost function (technical change), movements along the production/cost function (scale economies), and market imperfections [Hall 1989; Henderson 1984]. For sector i this can be written as:

$$\dot{TFP}_i = \dot{TP}_i + (\gamma_i - 1)\,\dot{Q}_i + (\mu_i - 1)\,\dot{Q}_i \qquad (11)$$

where

$\dot{TP}$ = technical progress;

γ = returns to scale parameter, $\gamma_i > 1$ implies increasing returns to scale in the sector; and

μ = market power parameter, measured as the ratio of output price to marginal cost, $\mu_i > 1$ implies market power in the sector.

Under the assumption of constant returns to scale ($\gamma = 1$) and marginal cost pricing ($\mu = 1$), the growth in TFP will be equal to technical progress. When these conditions are not fulfilled, TFP growth depends on gross output growth. But output growth itself depends on TFP growth. Thus any exogenous adverse shock to TFP from either the supply side (e.g., an energy price shock) or the demand side (e.g., a recession) will, all other things being equal, create a vicious circle of lower growth in output, real incomes, and TFP. Conversely, any advantageous shock will create a virtuous circle.

An Overview of Productivity and Cost Trends in Canada

In this section, we discuss the trends in gross output, total factor productivity, input prices, and total unit costs that have characterized broad Canadian industrial sectors (17 two-digit manufacturing and 10 nonmanufacturing industries). We also discuss the trends in aggregate TFP growth. We concentrate on the differences in growth rates in the 1962-73 and 1974-88 periods. The year 1973 coincides with the first oil price shock and is generally considered the point at which a widespread worldwide productivity slowdown began.

Our analysis is based on unpublished data on gross output, factor inputs (including purchased services), and factor prices from Statistics Canada and the U.S. Department of Labor.[3] The shares of individual inputs in total costs for the Canadian and the U.S. industries are given in Appendix B.[4]

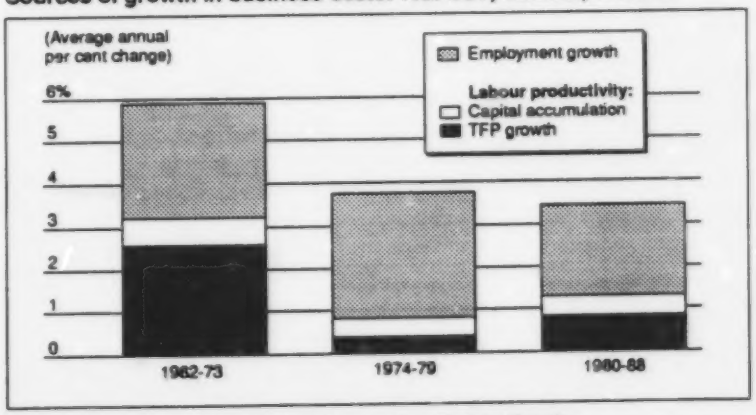
Trends in Sectoral Outputs and TFP

In every major industrial sector, with the exception of fishing and trapping, output growth declined substantially during the post-1973 period, compared to the performance in the 1962-73 period (see Table 1). In mining and utilities, annual output growth fell by over 3 percentage points. The output of the manufacturing sector increased by a mere 2.7 per cent per year during the 1974-88 period, compared to 6.5 per cent during the first period. The nonmanufacturing sector did much better – its output growth only declined from 5.6 per cent during the first period to 3.9 per cent in the second. Overall, Canadian business-sector real GDP growth dropped from 5.9 per cent per year during the first period to 3.6 per cent in the second period.

As shown in the previous section, the output growth of an industry is equal to the growth in its TFP and the weighted sum of the growth rates in factor inputs (see equation 5). Our empirical results show that about 80 per cent of the slowdown in Canadian business-sector GDP growth between the periods 1962-73 and 1974-88 resulted from a reduction in TFP growth (see Table 1 and Figure 1). Growth in TFP fell in all sectors between the two periods with the exception of forestry, fishing and construction. These results, in turn, imply that the drop in output growth in these industries was either directly or indirectly caused by the slowdown in TFP growth, because the demand for inputs itself depends primarily on output growth.[5] The direct effect of the TFP growth slowdown accounted for about two-thirds of the fall in aggregate nonmanufacturing output growth (see Table 1 and Figure 2).

Figure 1

Sources of growth in business-sector real GDP, Canada, 1962-88



Source Estimates by the authors, based on data from Statistics Canada.

Table 1

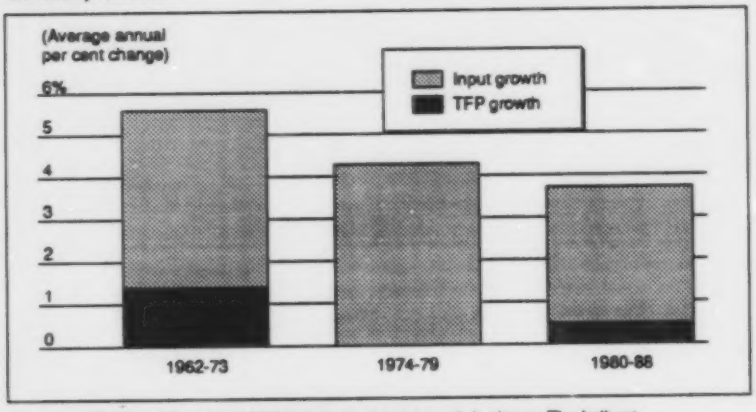
Average annual growth in gross output (constant prices) and total factor productivity, Canadian industries, 1962-88

	1962-73		1974-88		1974-79		1980-88	
	Gross output	Total factor productivity	Gross output	Total factor productivity	Gross output	Total factor productivity	Gross output	Total factor productivity
	(Average annual per cent change)							
Agriculture	3.8	2.4	1.8	0.5	1.8	–1.8	1.7	2.1
Fishing	1.0	–2.6	2.9	1.2	3.9	–1.2	2.3	2.9
Forestry	4.1	2.0	3.3	2.2	1.4	0.6	4.6	3.3
Mining	7.6	2.3	1.8	–1.5	0.7	–4.2	2.5	0.3
Construction	4.2	0.2	2.9	0.6	3.6	0.7	2.5	0.6
Transportation, storage, and communications	7.1	3.5	4.6	2.2	5.9	2.6	3.7	1.9
Utilities	8.8	3.6	4.4	0.9	5.7	0.2	3.6	1.4
Wholesale and retail trade	5.5	2.2	3.9	0.9	3.3	0.1	4.2	1.4
Finance, insurance, and real estate	5.9	–0.7	5.2	–1.2	6.0	–0.8	4.6	–1.4
Community, business, and personal services	6.3	–0.2	5.3	–0.1	5.8	0.3	5.0	–0.4
Primary industries[1]	5.3	2.8	1.8	–0.5	1.1	–2.8	2.3	1.1
Service industries[2]	5.7	1.0	4.2	0.4	4.8	0.5	3.9	0.4
Nonmanufacturing	5.6	1.4	3.9	0.3	4.3	0.0	3.7	0.5
Manufacturing	6.5	1.6	2.7	0.3	2.8	0.5	2.6	0.2
Business sector[3]	5.9	2.6	3.8	0.7	3.8	0.4	3.4	0.9

1 Includes agriculture, fishing, forestry, and mining.
2 Includes construction; transportation, storage, and communications; utilities; wholesale and retail trade; finance, insurance, and real estate; and community, business, and personal services.
3 Output is GDP at 1986 constant prices. TFP is based on net output.
Source Estimates by the authors, based on data from Statistics Canada.

Figure 2

Sources of growth in nonmanufacturing real gross output,[1] Canada, 1962-88



1 Only the direct influence of TFP growth on output growth is shown. The indirect influence can be large, as explained in the text.

Source Estimates by the authors, based on data from Statistics Canada.

In contrast, in the aggregate manufacturing sector, the slowdown in TFP directly accounted for only about 34 per cent of the fall in output growth (see Table 1 and Figure 3). However, intermediate inputs account for an average of over two-thirds of the total input costs in the manufacturing sector. Therefore, a large part of the slowdown in input growth itself can be attributed to the slowdown in output growth, because the demand for inputs depends on sales. Thus the total contribution of the TFP slowdown to the slowdown in output will be substantially larger than the direct effect, because of its indirect impact on input growth and, hence, on output growth.[6] This issue is examined in greater detail in the following two sections.

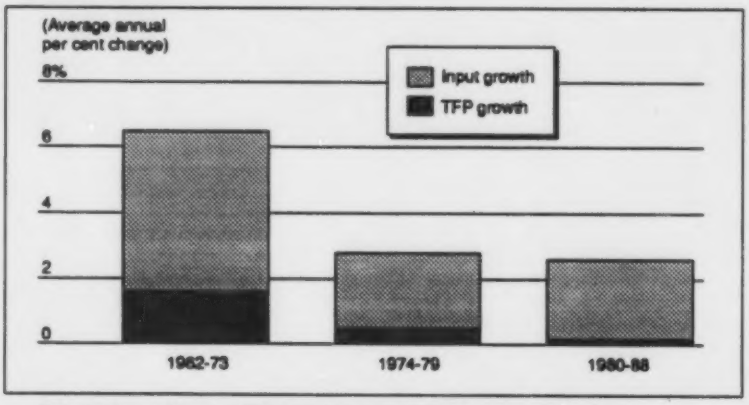
Over the entire 1962-88 period, TFP growth averaged between 0.8 and 0.9 per cent per year in both the manufacturing and nonmanufacturing sectors. However, TFP growth appears to be more favourable in the nonmanufacturing sector. TFP remained constant in the 1974-79 period, but rose at an average rate of 0.5 per cent per year in the 1980-88 period. While still significantly below the growth rate of the 1962-73 period (1.4 per cent), it was nevertheless higher than the growth rate in the manufacturing sector. What is more, the TFP growth rate of aggregate manufacturing appears to be on a declining trend (see Figures 2 and 3).

Unit Costs, Input Prices, and TFP

Equation (9) showed that changes in unit costs are equal to the weighted sum of changes in input prices less the growth in TFP. In most of the Cana-

Figure 3

Sources of growth in manufacturing real gross output,[1] Canada, 1962-88



1 Only the direct influence of TFP growth on output growth is shown. The indirect influence can be large, as explained in the text.

Source: Estimates by the authors, based on data from Statistics Canada.

dian industrial sectors, growth in unit costs accelerated dramatically during the 1974-88 period, compared to the experience of the 1960s and early 1970s (see Table 2). For instance, in the manufacturing sector, unit costs increased at an average annual rate of 7.7 per cent in the 1974-88 period, compared to a 2.7-per-cent increase in the earlier period. Of course, much of the acceleration occurred during the first six years of the second period (1974-79). But, even during the 1980s, unit costs increased much faster than in the 1962-73 period.

Only a relatively small portion of the increase in the growth rate of unit costs between 1962-73 and 1974-88 in the majority of sectors can be directly attributed to the TFP growth slowdown. Most of the increase was directly due to the accelerating growth of input prices. Thus, in the manufacturing sector, about three-quarters of the increased unit cost growth between the two periods can be explained in terms of the increase in input prices. Similarly, in the aggregate nonmanufacturing sector, input price increases accounted for about 70 per cent of the acceleration in the growth of unit costs.

Thus, reduced TFP growth was directly responsible for only about one-quarter of the cost inflation problems of the 1970s and the early 1980s. However, from Table 2 it is clear that the variation in unit costs across industries was much greater than that in input prices. In other words, changes in input price inflation tended to be fairly similar across industries. As a result, trends in relative costs across industries in the two periods were largely influenced by the relative growth rates in TFP.

Table 2

Average annual growth in aggregate input price and total unit costs, Canadian industries, 1962-88

	1962-73		1974-88		1974-79		1980-88	
	Input price	Unit costs	Input price	Unit costs	Input price	Unit costs	Input price	Unit costs
	(Average annual per cent change)							
Agriculture	7.9	5.6	6.0	5.5	9.0	10.8	4.0	2.0
Fishing	6.3	8.8	10.1	8.8	13.7	14.9	7.7	4.8
Forestry	6.2	4.2	9.3	7.1	12.3	11.7	7.3	4.1
Mining	5.5	3.2	8.4	9.9	14.6	18.8	4.2	3.9
Construction	5.3	5.1	8.0	7.3	10.2	9.5	6.5	5.9
Transportation, storage, and communications	5.7	2.1	8.3	6.1	11.0	8.4	6.5	4.6
Utilities	4.2	0.6	10.1	9.2	13.3	13.1	7.9	6.5
Wholesale and retail trade	5.4	3.2	8.0	7.1	9.7	9.7	6.8	5.4
Finance, insurance, and real estate	3.2	3.9	6.6	7.8	7.5	8.3	6.0	7.5
Community, business, and personal services	4.4	4.5	7.2	7.4	9.3	9.0	5.8	6.2
Primary industries[1]	7.0	4.2	7.0	7.5	11.5	14.4	4.0	3.0
Service industries[2]	4.8	3.7	6.4	7.3	9.6	9.2	7.7	6.0
Nonmanufacturing	5.2	3.8	7.6	7.2	10.0	9.9	6.0	5.4
Manufacturing	4.3	2.7	8.0	7.7	12.2	11.7	5.3	5.1

1 Includes agriculture, fishing, forestry, and mining.

2 Includes construction; transportation, storage, and communications; utilities; wholesale and retail trade; finance, insurance, and real estate; and community, business, and personal services.

Source Estimates by the authors, based on data from Statistics Canada.

Trends in Labour Productivity and TFP: An Aggregate Picture

Using the aggregation procedure outlined in the section entitled "Analytical Framework," we have analysed the relationship between labour productivity growth, TFP growth, capital accumulation, interindustry shifts in primary inputs, and terms-of-trade changes in the Canadian economy during the 1962-88 period. Business-sector real GDP grew at an annual rate of 5.9 per cent during the 1962-73 period (see Table 3 and Figure 1). Employment growth accounted for about 45 per cent of this growth. The remaining 55 per cent resulted from improvements in labour productivity, which was caused primarily by improvements in total factor productivity. Growth in the capital/labour ratio contributed to about 20 per cent of the growth in labour productivity. Thus TFP growth was a major source of growth in both real output (GDP) and labour productivity in the business sector during the 1960s and early 1970s (see Table 3 and Figure 1).

Business-sector real GDP growth declined to 3.6 per cent in the 1974-88 period, mainly because of slower labour productivity growth. The slowdown in labour productivity accounted for nearly 80 per cent of the slowdown in GDP growth between the two periods. In turn, this was almost entirely caused by the drop in aggregate TFP growth. It declined from 2.6 per cent in the 1962-73 period to 0.7 per cent during the 1974-88 period. These results suggest that, on average, capital accumulation played relatively little role in the productivity slowdown in Canada. This result is consistent with the findings of earlier studies [Rao and Preston 1984; Helliwell 1984; Stuber 1986; Sharpe 1982]. However, it is important to keep in mind here that this analysis does not take into account the contribution of changes in the quality or allocation of capital.

Table 3 shows that the difference between the aggregate TFP growth measure and the sum of the individual industry TFP growth rates (calculated as shown in equation 2) was fairly small in the first period and zero in the post-1973 period. This suggests that shifts in primary inputs between sectors had virtually no effect in the second period [see Rao and Preston 1984; Sharpe 1982]. But it should be noted that these shifts accounted for 0.3 points out of the 1.9-percentage-point (16 per cent) slowdown in TFP growth between 1962-73 and 1974-88.

In summary, slower sectoral TFP growth rates were mainly responsible for the weak labour productivity growth experienced during the 1974-88 period. Slower capital accumulation, on average, played only a small role. The slowdown in labour productivity was in turn the primary cause of the slowdown in output growth, both directly and indirectly. In other words, the poor performance of the Canadian economy in the post-1973 period compared

Table 3

Sources of real output growth in the Canadian business sector,[1] 1962-88

	GDP (1)	Employment (2)	Labour productivity 3 = (1) – (2)	Total factor productivity (aggregate measure) (4)	Capital contribution (5)	Total factor productivity (weighted sum of industry growth rates) (6)	Effects of terms-of-trade changes plus interindustry shifts in primary inputs 7 = (4) – (6)
	(Average annual per cent change)						
1962-73	5.9	2.7	3.2	2.6	0.7	2.3	0.3
1974-88	3.6	2.5	1.1	0.7	0.4	0.7	0.0
1974-79	3.8	2.9	0.9	0.4	0.4	0.3	0.1
1980-88	3.4	2.2	1.2	0.9	0.4	0.9	0.0

1 Data may not add due to rounding.
Source Estimates by the authors, based on data from Statistics Canada.

to the 1960s – i.e., such things as sluggish growth in real wages, increases in the unemployment rate and acceleration of inflation – can be largely blamed on the drop in sectoral TFP growth rates. Thus Canada's future economic performance critically depends upon addressing and overcoming this problem.

Canada-U.S. Manufacturing TFP and Cost Comparisons

In the previous section, we reviewed the trends in TFP and unit costs in broad Canadian industrial sectors. These results indicated that the growth rates of output and TFP have declined dramatically in the post-1973 period in almost all sectors. In this section, we compare the trends in input prices, input productivities, TFP, input costs, and output price in the aggregate Canadian manufacturing sector with those in the United States.

Obviously, exchange-rate movements play an important role in relative competitiveness and, for reference purposes, we note here the broad trends which have characterized the Canada-U.S. exchange rate in the past three decades. Over the 1962-73 period it remained fairly constant, but between 1974 and 1986 it depreciated in Canada's favour by an average of 2.4 per cent per year (about 30 per cent altogether). Between 1986 and 1991 it appreciated a total of about 20 per cent although it has since declined.

In Appendix A, we present details on the productivity and cost trends in eight major manufacturing industries: food and beverages; paper and allied products; wood products; primary metal products; transportation equipment; chemical products; electrical machinery; and nonelectrical machinery. In the manufacturing sector, these industries account for about 70 per cent of the total value-added, about 60 per cent of total employment, and almost 90 per cent of total exports.

Trends in TFP

The TFP growth rate of the aggregate manufacturing sector declined from 1.6 per cent per year during the 1962-73 period to only 0.3 per cent in the 1974-88 period. Every industry (except wood products) experienced a slowdown in productivity, often a dramatic slowdown (see Table 4). Moreover, in the 1974-88 period, five out of the 17 manufacturing industries experienced either no growth or a fall in TFP.

But the slowdown in TFP growth was not unique to Canada. In the United States, the manufacturing sector's TFP growth rate also fell – from 1.1 per

Table 4

Average annual growth in total factor productivity, Canadian and U.S. manufacturing industries, 1962-88

	1962-73		1974-88		1974-79		1980-88	
	Canada	United States	Canada	United States	Canada	United States	Canada	United States
	(Average annual per cent change)							
Aggregate manufacturing	1.8	1.1	0.3	0.6	0.5	–0.0	0.2	0.9
Food and beverages	1.0	0.8	0.0	0.3	0.3	–0.1	–0.1	0.6
Paper and allied products	0.6	1.3	–0.1	0.6	0.3	–0.3	–0.4	1.1
Primary metal products	1.1	0.5	0.4	–0.4	–0.7	–1.7	1.2	0.5
Wood products	0.8	2.2	1.4	0.8	0.9	0.4	1.8	1.1
Chemicals	2.2	1.8	0.4	0.5	–0.9	–0.4	1.2	1.1
Nonelectrical machinery[1]	1.6	1.7	–0.2	2.4	0.9	1.0	–0.9	3.4
Electrical products[1]	2.7	2.6	2.3	1.8	2.4	1.8	2.3	1.8
Transportation equipment	2.8	1.4	0.1	0.4	0.4	0.1	–0.1	0.6
Nonmetallic mineral products	2.3	0.7	0.5	0.2	–0.1	–0.5	1.0	0.6
Fabricated metal products	1.7	0.7	0.1	0.5	0.2	–0.2	0.0	1.0
Furniture and fixtures	1.8	1.1	–0.5	0.4	–0.4	0.6	–0.8	0.2
Textiles and clothing	2.1	1.4	1.4	0.9	2.8	1.0	0.5	0.9
Printing and publishing	1.0	0.4	0.4	–0.3	1.6	–0.4	–0.4	–0.3
Tobacco	1.3	1.0	0.1	–1.7	0.6	–0.7	–0.2	–2.4
Rubber and plastics	2.3	0.9	0.9	0.8	2.1	–0.7	0.1	1.7
Petroleum refining	0.9	0.3	0.2	–0.3	0.0	0.2	0.3	–0.6
Miscellaneous manufacturing	1.4	1.8	–0.1	0.8	1.0	0.2	–0.8	1.2

1 Computers are included with electrical products for Canada, and with nonelectrical machinery for the United States.

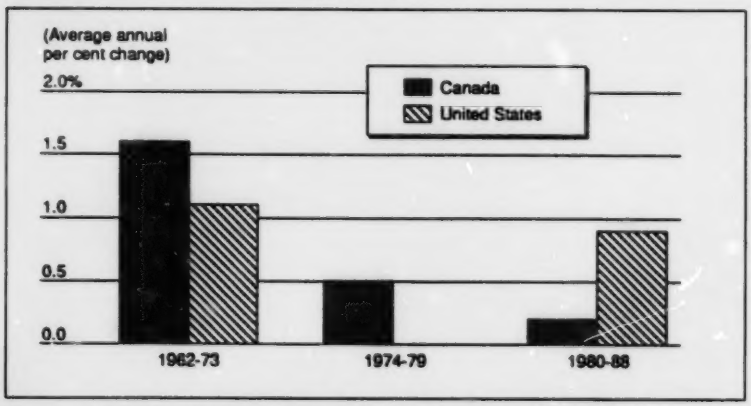
Source Estimates by the authors, based on data from Statistics Canada and the U.S. Department of Labor.

cent during the 1962-73 period to 0.6 per cent in the 1974-88 period. As in Canada, the productivity problem was not confined to just a few industries. Instead, TFP growth slowed markedly in all but one of the 17 manufacturing industries during the second period (see Table 4). Only the nonelectrical machinery industry experienced a TFP growth acceleration in the post-1973 period.

In short, in both Canada and the United States TFP grew at a much slower pace in the post-1973 period, compared to the productivity record of the 1960s and early 1970s. Canadian manufacturing productivity increased at a slightly higher pace than in the U.S. sector during the 1962-88 period. However, the Canadian industries, on average, experienced a much greater slowdown in TFP. The Canadian TFP growth rate fell by 1.3 percentage points compared to a decline of only 0.5 percentage points in the United States. A closer look at the 1974-88 period indicates that the United States did much worse than Canada in the 1974-79 period but did much better in the 1980-88 period (see Figure 4). In fact, the United States experienced a recovery in TFP growth in the 1980-88 period almost to the pre-1973 level. It is worrying that this same trend did not occur in Canada. Instead, TFP growth in Canada continued to decline in the 1980-88 period, with 12 of the 17 manufacturing industries undergoing a further decline. Consequently, manufacturing TFP growth averaged a mere 0.2 per cent in Canada in the 1980s, compared to 0.9 per cent in the United States.

Figure 4

Growth in manufacturing total factor productivity, Canada and the United States, 1962-88



SOURCE Estimates by the authors, based on data from Statistics Canada and the U.S. Department of Labor.

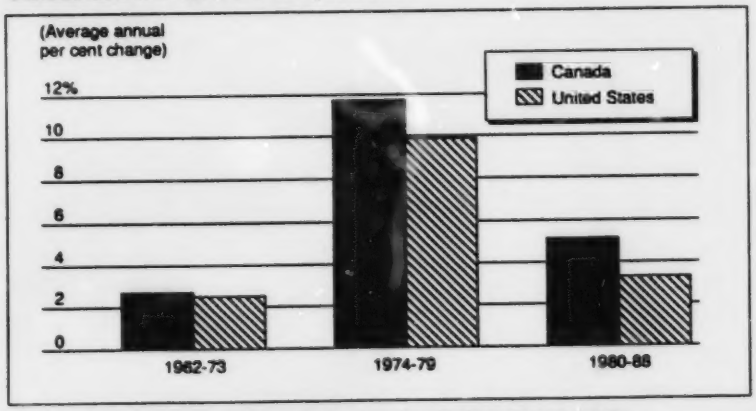
Trends in Unit Costs

In Canada, the growth of average manufacturing sector total unit costs increased from 2.7 per cent per year during the 1962-73 period to 11.7 per cent in 1974-79, and 5.1 per cent in 1980-88 (see Table 5 and Figure 5). The slowdown in TFP growth, on average, directly accounted for only about 25 per cent of the acceleration in manufacturing-sector price inflation. However, its full impact was much larger. Intermediate inputs account for over 65 per cent of total unit costs in manufacturing so that the drop in TFP growth also contributed significantly to the acceleration of output price inflation *indirectly*, because of interindustry linkages. Moreover, the trends in relative unit costs (output prices) across individual manufacturing industries were largely influenced by the relative growth rates in TFP. For example, the output price of the Canadian electrical products industry increased at a rate of 3.7 per cent per year during the 1974-88 period, compared to 8.3 per cent in the non–electrical machinery industry. The difference in total factor productivity performance during the period accounted for almost 50 per cent of this difference in price performance.[7]

In the United States, growth in unit costs also accelerated substantially in all the manufacturing industries during the post-1973 period (see Figure 5). However, Canadian output price performance was significantly worse than the U.S. experience in almost all manufacturing industries. Canadian manufacturing costs, on average, increased 1.8-percentage-points faster per year

Figure 5

Growth in manufacturing total unit costs, Canada and the United States, 1962-88



Source Estimates by the authors, based on data from Statistics Canada and the U.S. Department of Labor.

Table 5

Average annual growth in total unit costs, Canadian and U.S. manufacturing industries, 1962-88

	1962-73		1974-88		1974-79		1980-88	
	Canada	United States	Canada	United States	Canada	United States	Canada	United States
	(Average annual per cent change)							
Aggregate manufacturing	2.7	2.5	7.7	5.9	11.7	9.9	5.1	3.3
Food and beverages	4.2	4.0	6.9	4.6	10.0	7.5	4.8	2.7
Paper and allied products	2.6	2.1	9.5	7.3	13.7	10.5	6.7	5.1
Primary metal products	3.2	3.0	8.8	7.6	14.2	13.0	5.2	4.0
Wood products	6.2	5.4	5.4	4.7	10.1	9.2	2.3	1.6
Chemicals	1.2	0.6	9.2	7.6	13.3	11.9	6.5	4.8
Nonelectrical machinery[1]	2.8	2.4	8.3	2.4	11.5	7.5	6.1	-1.1
Electrical products[1]	1.9	0.7	3.7	4.6	7.7	6.8	1.0	3.3
Transportation equipment	1.8	2.2	7.7	6.3	10.3	8.8	6.1	4.6
Nonmetallic mineral products	2.8	2.6	8.6	6.7	11.2	10.7	6.8	4.0
Fabricated metal products	2.8	3.0	7.8	6.5	12.0	10.9	5.1	3.5
Furniture and fixtures	2.9	2.6	8.0	5.9	10.7	8.0	6.2	4.5
Textiles and clothing	1.4	1.8	6.0	4.1	8.4	5.3	4.4	3.3
Printing and publishing	4.1	3.3	7.9	7.0	9.0	9.0	7.2	5.8
Tobacco	3.1	2.4	8.7	10.2	9.1	9.7	8.4	10.5
Rubber and plastics	1.3	1.6	7.6	6.3	10.3	10.3	5.8	3.6
Petroleum refining	1.8	2.0	13.2	11.6	26.3	25.5	4.5	2.3
Miscellaneous manufacturing	2.6	2.2	7.7	5.5	10.7	7.9	5.6	3.9

1 Computers are included with electrical products for Canada, and with nonelectrical machinery for the United States.

Source Estimates by the authors, based on data from Statistics Canada and the U.S. Department of Labor.

than U.S. costs during this period. These results are consistent with the conclusions of our analysis of the relative unit labour cost position of Canadian manufacturing industries vis-à-vis their U.S. competitors [see Rao and Lemprière 1992*b*].

Inputs, TFP, and Output

The gross output of the Canadian manufacturing sector increased at an average annual rate of 6.5 per cent during the 1962-73 period. Growth in inputs accounted for about 75 per cent of this increase, with TFP growth contributing the rest (see Table 6). Nonlabour inputs (capital, energy, materials, and service inputs) increased at a much faster pace than the labour inputs. Consequently, the growth in labour productivity (4.1 per cent) exceeded the growth in TFP by 2.5 percentage points per year (see Table 7). The growth in the substitution of nonlabour inputs for labour, in turn, was due to the significant increase in the price of labour relative to other input prices (see Table 8). The relatively modest growth in nonlabour input prices and the improvements in TFP also served to moderate the growth in input costs and output price during this period (see Table 9).

Manufacturing output growth dropped to 2.7 per cent in the 1974-88 period, and as already discussed, much of the decline was either directly or indirectly related to the decline in TFP growth. Regression analysis suggests that 75 per cent of the output slowdown can be attributed to the direct and indirect effects of the TFP slowdown.[8] The remaining 25 per cent was due to the slowdown in demand (domestic and foreign) for manufacturing output. The slowdown in domestic demand (intermediate inputs and final), in turn, could be attributed to a slowdown in the nonmanufacturing industries, which would have an adverse effect on real incomes, and on demand by the nonmanufacturing industries for intermediate inputs from manufacturing industries.

As in the earlier period, nonlabour inputs (except energy) increased at a faster pace than labour during the 1974-88 period. As a result, the growth in labour productivity (2.0 per cent) exceeded the growth in total factor productivity by 1.7 percentage points per year. In addition, the contribution of TFP growth to labour productivity growth declined from about 40 per cent in the first period to 15 per cent in the second period (see Table 7).

The two oil price shocks in the 1974-88 period and the resulting sharp increase in the price of energy inputs relative to the prices of other inputs, reduced the use of energy relative to the other inputs in the Canadian manufacturing sector. Thus energy input productivity growth jumped from 0.6 per cent during the first period to 2.5 per cent in the second period (see Table 7).

Table 6

Average annual growth in output, inputs, and TFP in manufacturing, Canada and the United States, 1962-88

	Canada					United States				
	1962-88	1962-73	1974-88	1974-79	1980-88	1962-88	1962-73	1974-88	1974-79	1980-88
	(Average annual per cent change)									
Gross output	4.4	6.5	2.7	2.8	2.6	3.3	4.8	2.1	2.2	2.0
Inputs	3.5	4.9	2.4	2.3	2.4	2.5	3.7	1.5	2.2	1.1
Capital	3.5	4.3	2.9	2.1	3.4	3.5	4.0	3.1	3.9	2.6
Labour	1.4	2.3	0.7	0.8	0.6	0.8	1.9	–0.0	0.7	[illegible]
Energy	2.8	5.9	0.3	3.3	–1.7	2.0	4.9	–0.4	0.1	–0.7
Materials	4.6	6.5	3.1	2.6	3.5	3.0	4.5	1.8	2.3	1.5
Services	4.6	5.9	3.5	4.2	3.0	5.0	6.1	4.1	7.3	1.9
TFP	0.9	1.6	0.3	0.5	0.2	0.8	1.1	0.6	0.0	0.9

Source: Estimates by the authors, based on data from Statistics Canada and the U.S. Department of Labor.

Table 7
Average annual growth in input productivities and TFP in manufacturing, Canada and the United States, 1962-88

	Canada					United States				
	1962-88	1962-73	1974-88	1974-79	1980-88	1962-88	1962-73	1974-88	1974-79	1980-88
	(Average annual per cent change)									
TFP	0.9	1.6	0.3	0.5	0.2	0.8	1.1	0.6	0.0	0.9
Input productivities										
Capital	1.0	2.2	-0.0	0.8	-0.5	-0.2	0.8	-1.0	-1.6	-0.5
Labour	2.9	4.1	2.0	2.0	1.9	2.4	2.9	2.1	1.5	2.5
Energy	1.8	0.8	2.5	-0.4	4.4	1.4	0.0	2.5	2.0	2.8
Materials	-0.3	-0.0	-0.5	0.2	-0.9	0.3	0.3	0.3	-0.1	0.5
Services	-0.2	0.5	0.8	-1.4	-0.5	-1.4	-1.1	-1.6	4.5	0.3

Source Estimates by the authors, based on data from Statistics Canada and the U.S. Department of Labor.

Table 8

Average annual growth in output price, input prices, and TFP in manufacturing, Canada and the United States, 1962-88

	Canada					United States				
	1962-88	1962-73	1974-88	1974-79	1980-88	1962-88	1962-73	1974-88	1974-79	1980-88
	(Average annual per cent change)									
Gross output price	5.5	2.7	7.7	11.7	5.1	4.4	2.5	5.9	9.9	3.3
Input prices	6.4	4.3	8.0	12.2	5.3	5.2	3.6	6.5	9.9	4.2
Capital[1]	7.4	5.6	8.8	10.7	7.5	4.5	3.3	5.4	6.0	5.0
Labour	7.8	6.4	9.0	11.7	7.2	6.4	5.4	7.3	9.4	5.9
Energy	9.1	2.8	14.2	27.5	5.4	7.4	2.8	11.1	20.5	4.8
Materials	5.3	3.0	7.2	11.5	4.3	4.7	2.8	6.2	10.7	3.2
Services	5.4	3.1	7.2	9.3	5.8	5.2	3.4	6.7	7.5	6.2
TFP	0.9	1.6	0.3	0.5	0.2	0.8	1.1	0.6	0.0	0.9

1 Variations in the price of capital include variations in profit margins.

Source Estimates by the authors, based on data from Statistics Canada and the U.S. Department of Labor.

Table 9

Average annual growth in output price and input costs in manufacturing, Canada and the United States, 1962-88

	Canada					United States				
	1962-88	1962-73	1974-88	1974-79	1980-88	1962-88	1962-73	1974-88	1974-79	1980-88
	(Average annual per cent change)									
Gross output price	5.5	2.7	7.7	11.7	5.1	4.4	2.5	5.9	9.9	3.3
Input costs	5.5	2.7	7.7	11.7	5.1	4.4	2.5	5.9	9.9	3.3
Capital	6.1	3.1	8.4	9.8	7.5	4.7	2.3	6.5	8.2	5.4
Labour	4.9	2.2	7.0	9.6	5.2	4.0	2.4	5.2	7.8	3.4
Energy	7.6	2.3	11.8	28.2	0.9	6.0	2.8	8.6	18.5	2.0
Materials	5.6	3.1	7.7	11.2	5.3	4.4	2.5	5.9	10.8	2.6
Services	5.7	2.6	8.2	10.9	8.4	7.0	4.7	8.9	13.0	6.2

Source Estimates by the authors, based on data from Statistics Canada and the U.S. Department of Labor.

But the response of the input mix to the two dramatic changes in energy prices was, in general, slower and weaker in Canadian manufacturing than in the U.S. sector. For instance, during the first part of the second period (1974-79), the energy/output ratio (the inverse of energy productivity) increased at an average annual rate of 0.5 per cent in Canada, compared to a negative growth rate of 2.1 per cent in the United States (see Table 7).

As mentioned before, over the whole 1962-88 period, the TFP performance of the U.S. manufacturing sector was only slightly worse than that of Canada. A much better materials productivity growth performance in the United States was balanced by superior growth in the productivity of other inputs in Canada (see Table 7). However, the TFP slowdown was more pronounced in Canada, because of a much larger slowdown in labour productivity growth and a much smaller increase in energy productivity growth. Furthermore, materials productivity declined in Canada in the second period while its growth remained constant at 0.3 per cent in the United States in the two periods.

The dramatic improvement in TFP growth in the United States in the 1980-88 period occurred as a result of productivity improvements in all inputs except services. In sharp contrast, the decline in Canadian TFP growth between the periods 1974-79 and 1980-88 was due to reductions in the productivity growth of all inputs except energy.

However, the slowdown in input productivity growth was not completely pervasive in Canadian manufacturing. Both capital and labour experienced a continuing fall in productivity growth rate over the 1962-73, 1974-79, and 1980-88 periods. But energy and services productivity growth improved in the 1980-88 period after declines in the 1974-79 period, although the latter continued to have a negative growth. Overall, only energy productivity growth improved between 1962-73 and 1974-88. In the United States, on the other hand, productivity growth of both energy and materials either remained constant or improved between the two periods.

During the 1962-73 period, the average price of manufacturing inputs increased at a faster pace in Canada than in the United States (4.3 per cent compared to 3.6 per cent – a 0.7-percentage-point difference). But, because of faster growth in Canadian TFP, the gross output price of the Canadian manufacturing sector grew an average of only 0.2 percentage points per year faster than the U.S. rate (see Table 8).

As in Canada, the output price of the U.S. manufacturing sector increased at a much faster pace in the second period (1974-88), and a large portion (about 85 per cent) of this acceleration was directly due to faster growth in input prices. However, Canadian cost/price inflation was much larger than in the United States (see Table 8). It appears that the adverse effect of the two

energy price shocks on the wage-price spiral was much more pronounced and more long-lasting in Canada than in the United States because of weaker and slower adjustment in input mix to the changes in relative prices. This, in turn, could have created a vicious circle of poor productivity and cost/price performance in Canadian manufacturing industries, relative to their U.S. counterparts. We examine this issue in more detail when discussing the trends in major manufacturing industries in Appendix A.

The relative trends in costs and prices in the two countries imply that the Canadian manufacturing sector, on average, gained some competitive ground in relation to its U.S. counterpart up to the mid-1980s. The Canadian sector's poor cost performance during the 1974-88 period was more than offset by the large depreciation of the Canadian dollar during most of this period.[9] But the large appreciation of the Canadian dollar between 1986 and 1991 (an average of about 4 per cent a year) and the adverse trends in Canada's relative cost performance during the 1980s (Canadian costs rose an average of 1.8 percentage points faster per year than those in the United States) suggest that the competitive position of the Canadian manufacturing sector deteriorated substantially (between 30 and 35 per cent) during the 1986-91 period in relation to its U.S. counterpart.

Productivity and Costs in the Nonmanufacturing Industries

In this section, we first discuss the trends in TFP and total unit costs in the Canadian nonmanufacturing industries during the period 1962-88. We then compare the productivity and the cost/price performance of the Canadian industries with their U.S. counterparts using data on labour productivity, unit labour costs, and value-added prices.

TFP and Output

As in the manufacturing sector, the rate of growth of the nonmanufacturing sector's output declined substantially in Canada during the 1974-88 period, but the decline was less dramatic than the fall in the manufacturing sector. The sector's output growth rate declined from 5.6 per cent in the 1962-73 period to 3.9 per cent per year in the 1974-88 period (see Table 10A). The slowdown in TFP growth *directly* contributed to about two-thirds of the output growth slowdown between the two periods.

The slowdown in TFP and output of the agriculture; mining; utilities; transportation, storage, and communications; and wholesale and retail trade

Table 10

A Average annual growth in output, inputs, and TFP in nonmanufacturing, Canada, 1962-88

	1962-88	1962-73	1974-88	1974-79	1980-88
	(Average annual per cent change)				
Gross output	4.7	5.6	3.9	4.3	3.7
Inputs	3.9	4.2	3.6	4.3	3.2
Capital	4.2	4.5	3.9	4.7	3.4
Labour	3.0	2.8	3.1	3.7	2.7
Energy	3.5	7.0	0.7	3.6	−1.3
Materials	3.6	4.6	2.9	3.6	2.4
Services	6.1	6.8	5.6	6.0	5.3
TFP	0.8	1.4	0.3	0.0	0.5

B Average annual growth in input productivities and TFP in nonmanufacturing, Canada, 1962-88

	1962-88	1962-73	1974-88	1974-79	1980-88
	(Average annual per cent change)				
TFP	0.8	1.4	0.3	0.0	0.5
Input productivities					
Capital	0.5	1.1	0.0	−0.4	0.3
Labour	1.7	2.8	0.8	0.5	1.0
Energy	1.5	−1.2	3.6	0.8	5.5
Materials	1.0	1.0	1.1	0.7	1.3
Services	−1.4	−1.1	−1.6	−1.6	−1.5

Source: Estimates by the authors, based on data from Statistics Canada.

industries were the chief contributors to the poor performance of the Canadian nonmanufacturing sector during the 1974-88 period relative to the 1962-73 period. The slowdown in TFP growth directly accounted for about 55 to 120 per cent of the output slowdown in these five industries. In the remaining nonmanufacturing industries, TFP growth either increased or the slowdown was small (see Tables 12A to 21A).

TFP and Labour Productivity

Labour productivity growth also slowed dramatically in many of the Canadian nonmanufacturing industries during the 1974-88 period. Gross output-based labour productivity grew by an average of only 0.8 per cent per

year during the 1974-88 period, compared to 2.8 per cent during the 1962-73 period (see Table 10B). The slowdown in TFP directly accounted for 55 per cent of the slowdown in labour productivity growth, with slower growth of material and service inputs relative to the growth of labour accounting for much of the remainder. These results, in turn, imply that the TFP slowdown was directly responsible for most of the slowdown in output and labour productivity in the nonmanufacturing sector. The TFP slowdown may also have had a large indirect effect because the slowdown in intermediate input growth can be largely attributed to the slowdown in output growth (intermediate inputs account for about 40 per cent of aggregate nonmanufacturing output value). Nevertheless, the reduction in the growth rate of the capital/labour ratio contributed a great deal to the slowdown in labour productivity growth in agri-

Table 11

A Average annual growth in output price, input prices, and TFP in nonmanufacturing, Canada, 1962-88

	1962-88	1962-73	1974-88	1974-79	1980-88
	(Average annual per cent change)				
Gross output price	5.7	3.8	7.2	9.9	5.4
Input prices	6.5	5.2	7.5	9.9	5.9
Capital[1]	5.8	5.1	6.4	9.0	4.6
Labour	7.7	6.9	8.4	10.3	7.2
Energy	7.1	2.0	11.1	17.3	6.9
Materials	5.7	3.8	7.2	10.3	5.1
Services	5.5	3.6	7.0	8.6	6.0
TFP	0.8	1.4	0.3	0.0	0.5

B Average annual growth in output price and input costs in nonmanufacturing, Canada, 1962-88

	1962-88	1962-73	1974-88	1974-79	1980-88
	(Average annual per cent change)				
Gross output price	5.7	3.8	7.2	9.9	5.4
Input costs	5.7	3.8	7.2	9.9	5.4
Capital	5.3	3.9	6.5	9.5	4.5
Labour	6.0	4.0	7.6	9.7	6.2
Energy	5.7	3.3	7.7	16.3	1.9
Materials	4.6	2.7	6.0	9.6	3.7
Services	7.0	4.7	8.7	10.3	7.6

1 Variations in the price of capital include variations in profit margins.
Source Estimates by the authors, based on data from Statistics Canada.

Table 12

A Average annual growth in output, inputs, and TFP in agriculture, Canada, 1962-88

	1962-88	1962-73	1974-88	1974-79	1980-88
	(Average annual per cent change)				
Gross output	2.6	3.8	1.8	1.8	1.7
Inputs	1.3	1.4	1.3	3.6	–0.4
Capital	0.7	2.0	–0.4	5.2	–4.0
Labour	–0.9	–3.2	0.9	1.8	0.3
Energy	1.3	4.7	–1.5	1.3	–3.3
Materials	3.6	4.5	2.8	4.4	1.7
Services	3.2	4.6	2.1	3.8	1.0
TFP	1.3	2.4	0.5	–1.8	2.1

B Average annual growth in input productivities and TFP in agriculture, Canada, 1962-88

	1962-88	1962-73	1974-88	1974-79	1980-88
	(Average annual per cent change)				
TFP	1.3	2.4	0.5	–1.8	2.1
Input productivities					
Capital	2.1	1.8	2.4	–3.2	6.1
Labour	3.8	7.3	1.0	0.1	1.5
Energy	1.7	–0.8	3.7	0.8	5.6
Materials	–0.8	–0.6	–0.9	–2.4	0.1
Services	–0.5	–0.8	–0.2	–1.7	0.9

Source Estimates by the authors, based on data from Statistics Canada.

culture; forestry; fishing; utilities; and community, business, and personal services industries (see Tables 12B to 21B).

Input Substitution and TFP

As in the manufacturing industries, the relative productivity and cost performance of the Canadian nonmanufacturing industries during the 1974-88 period was significantly influenced by the ease with which they were able to adjust their input mix to changes in relative prices. For example, the mining industry's TFP growth rate declined from 2.3 per cent per year during the 1962-73 period to –1.5 per cent per year in the 1974-88 period. This industry's adjustment to the two energy price shocks was substantially slower and weaker

Table 13

A Average annual growth in output, inputs, and TFP in forestry, Canada, 1962-88

	1962-88	1962-73	1974-88	1974-79	1980-88
	(Average annual per cent change)				
Gross output	3.7	4.1	3.3	1.4	4.6
Inputs	1.6	2.1	1.1	0.8	1.3
Capital	–0.8	2.9	–3.7	–0.3	–6.0
Labour	–0.5	–0.6	–0.4	0.3	–0.9
Energy	2.8	5.8	0.3	–2.2	1.9
Materials	5.0	5.2	4.9	2.5	6.5
Services	4.4	5.9	3.2	1.8	4.1
TFP	2.1	2.0	2.2	0.6	3.3

B Average annual growth in input productivities and TFP in forestry, Canada, 1962-88

	1962-88	1962-73	1974-88	1974-79	1980-88
	(Average annual per cent change)				
TFP	2.1	2.0	2.2	0.6	3.3
Input productivities					
Capital	4.8	1.2	7.8	1.9	11.7
Labour	4.2	4.9	3.8	1.0	5.6
Energy	1.8	–1.4	4.4	4.3	4.4
Materials	–1.0	–0.6	–1.3	–0.5	–1.8
Services	–0.5	–1.4	0.2	–0.5	0.7

Source Estimates by the authors, based on data from Statistics Canada.

in comparison to the other nonmanufacturing industries. Its energy/output ratio, instead of declining, increased by 0.5 per cent per year during the 1974-88 period (see Table 15B). Only in the 1980-88 period did the ratio decline after a substantial increase in the 1974-79 period. The fishing and wholesale and retail trade industries also experienced an increase in their energy/output ratios in the 1974-79 period, but over the whole 1974-88 period the ratios did decline (see Tables 12B to 21B).

On the other hand, the forestry industry adjusted its input mix faster than did other industries. Its energy usage responded immediately to the oil price shock and the energy/output ratio declined by 4.3 per cent per year during the 1974-79 period, much lower than the average decline of only 0.8 per cent for the nonmanufacturing sector as a whole. Because of its apparent greater

ability to adjust its input mix, the productivity performance of the forestry industry, during the 1974-88 period, was substantially better than that of any other nonmanufacturing industry. Its TFP grew at an average rate of 2.2 per cent per year during this period, compared to an average growth rate of a mere 0.3 per cent for the nonmanufacturing sector as a whole.

Costs, Input Prices, and TFP

The cost/price performance of the nonmanufacturing industries deteriorated substantially during the 1974-88 period (see Table 11A). The acceleration in input price inflation, on average, accounted for over 65 per cent of the acceleration in output price inflation. The slowdown in TFP accounted for the rest.

Table 14

A Average annual growth in output, inputs, and TFP in fishing, Canada, 1962-88

	1962-88	1962-73	1974-88	1974-79	1980-88
	(Average annual per cent change)				
Gross output	2.1	1.0	2.9	3.9	2.3
Inputs	2.5	3.6	1.7	5.1	–0.6
Capital	1.8	4.7	–0.5	4.7	–4.0
Labour	4.2	3.3	4.9	5.2	4.7
Energy	2.9	7.4	–0.7	9.5	–7.4
Materials	3.9	3.7	4.0	8.3	1.1
Services	4.4	3.6	5.0	7.7	3.2
TFP	–0.4	–2.6	1.2	–1.2	2.9

B Average annual growth in input productivities and TFP in fishing, Canada, 1962-88

	1962-88	1962-73	1974-88	1974-79	1980-88
	(Average annual per cent change)				
TFP	–0.4	–2.6	1.2	–1.2	2.9
Input productivites					
Capital	1.2	–2.4	4.2	–0.1	7.0
Labour	–1.2	–1.5	–1.1	–0.0	–1.8
Energy	2.9	–4.7	8.9	–3.5	17.2
Materials	–1.1	–2.3	–0.1	–3.8	2.4
Services	–2.0	–2.4	–1.7	–3.4	–0.6

Source Estimates by the authors, based on data from Statistics Canada.

Table 15

A Average annual growth in output, inputs, and TFP in mining, Canada, 1962-88

	1962-88	1962-73	1974-88	1974-79	1980-88
	(Average annual per cent change)				
Gross output	4.4	7.6	1.8	0.8	2.5
Inputs	4.2	5.3	3.3	5.0	2.2
Capital	5.4	6.5	4.5	5.1	4.1
Labour	1.3	1.6	1.1	2.2	0.4
Energy	5.4	9.0	2.5	4.9	0.8
Materials	6.0	8.4	4.1	8.8	1.0
Services	6.4	8.1	5.1	6.0	4.4
TFP	0.2	2.3	–1.5	–4.2	0.3

B Average annual growth in input productivities and TFP in mining, Canada, 1962-88

	1962-88	1962-73	1974-88	1974-79	1980-88
	(Average annual per cent change)				
TFP	0.2	2.3	–1.5	–4.2	0.3
Input productivities					
Capital	–0.8	1.1	–2.3	–4.2	–1.0
Labour	3.1	5.9	0.8	–1.5	2.3
Energy	–0.8	–1.3	–0.5	–4.0	1.9
Materials	–1.3	–0.5	–1.9	–7.5	1.8
Services	–1.9	–0.5	–3.1	–5.1	–1.7

Source: Estimates by the authors, based on data from Statistics Canada.

However, as mentioned before, the decline in the industries' TFP growth may have caused the increase in the acceleration of input price inflation because of strong interindustry linkages. Therefore, the total effect of the TFP slowdown on the acceleration of output price inflation might be fairly large (about 45 to 50 per cent). A similar cost/price picture emerges from the individual nonmanufacturing industries (see Table 2).

Comparison of Trends in Canada and the United States

The data necessary to calculate TFP and total unit costs are not available for the U.S. nonmanufacturing industries. Thus we compare these industries in Canada and the United States by examining growth in labour productivity,

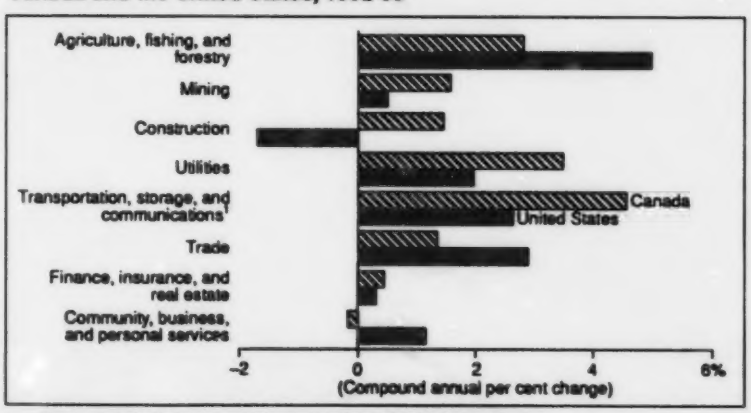
unit labour costs (both based on value-added), and the value-added deflator (price) for the 1961-86 period. These data are shown in Tables 22-24. Figure 6 summarizes the differences in labour productivity growth. The value-added deflator captures the influence of both labour and capital costs on output prices. This indicator is a more appropriate indicator of costs than unit labour costs in industries where capital costs are substantial.

Exchange-rate movements inevitably play a vital role in determining relative competitiveness and these considerations are also discussed. However, exchange rates have somewhat less direct relevance here than for the manufacturing industries since much of the output of the Canadian nonmanufacturing sector does not directly compete with U.S. nonmanufacturing output. The industries which will be most susceptible to exchange-rate fluctuations are likely to be farming, mining, and to a lesser extent, utilities, and transportation, storage, and communications.

Before we proceed with the discussion of results, it is important to note that the quality of output (value-added) data for many of the service industries is very poor compared to the data for the goods-producing industries in both Canada and the United States. In addition, some researchers have uncovered large potential errors in the measurement of U.S. industry productivity data for the 1974-86 period, especially in the construction, transportation, and trade industries [see Baily and Gordon 1988]. Therefore, one has to be cautious in using these data.

Figure 6

Growth in labour productivity,[1] nonmanufacturing industries, Canada and the United States, 1962-86



1 Does not include the communications industry for the United States.
Source Estimates by the authors, based on data from Statistics Canada.

Table 16

A Average annual growth in output, inputs, and TFP in construction, Canada, 1962-88

	1962-88	1962-73	1974-88	1974-79	1980-88
	(Average annual per cent change)				
Gross output	3.5	4.2	2.9	3.6	2.5
Inputs	3.0	4.0	2.2	2.9	1.9
Capital	4.7	3.7	5.4	7.9	3.7
Labour	1.9	2.3	1.6	2.1	1.3
Energy	1.8	4.5	–0.4	3.7	–3.1
Materials	3.4	4.9	2.3	2.8	2.0
Services	4.8	6.6	3.4	3.7	3.1
TFP	0.5	0.2	0.7	0.7	0.6

B Average annual growth in input productivities and TFP in construction, Canada, 1962-88

	1962-88	1962-73	1974-88	1974-79	1980-88
	(Average annual per cent change)				
TFP	0.5	0.2	0.7	0.7	0.6
Input productivities					
Capital	–1.0	0.7	–2.3	–3.9	–1.2
Labour	1.6	1.9	1.4	1.6	1.2
Energy	3.1	0.1	5.5	0.6	8.7
Materials	0.2	–0.6	0.8	0.9	0.7
Services	–1.2	–2.2	–0.3	–0.1	–0.5

Source Estimates by the authors, based on data from Statistics Canada.

Farming

Since the U.S. data is not disaggregated into agriculture, forestry, and fishing and trapping, Canada-U.S. comparisons are possible only for the total farming sector. In Canada, agriculture accounted for about 75 per cent of the total value-added of the sector in 1986. Forestry accounted for about 19 per cent, and fishing and trapping accounted for the remainder.

The Canadian farm sector's labour productivity (value-added per hour worked) increased at an annual rate of 5.3 per cent between 1962 and 1973, compared to a 4.3 per cent annual rise in the United States. The large increase in productivity, in turn, moderated the increases in unit labour costs (about 3.0 per cent per year) in the two countries during this period. How-

ever, the value-added deflator rose substantially during this period in both Canada (6.4 per cent) and the United States (7.9 per cent), implying a large increase in unit capital costs. The rise in capital costs could have been caused by a large decline in capital productivity and/or by a marked increase in the cost of capital and in profit margins. In any case, the labour productivity and cost/price record of the farm sector was very similar in both countries during the 1962-73 period. Nevertheless, the trends in the value-added deflators in the two countries suggest a significant improvement in the competitive position of the Canadian farm sector (the exchange rate remained fairly stable in this period).

The Canadian farm sector's labour productivity growth declined dramatically during the 1974-86 period, mostly because of the poor performance of

Table 17

A Average annual growth in output, inputs, and TFP in the utility industry, Canada, 1962-88

	1962-88	1962-73	1974-88	1974-79	1980-88
	(Average annual per cent change)				
Gross output	6.4	8.8	4.4	5.7	3.6
Inputs	4.3	5.2	3.5	5.5	2.2
Capital	4.2	5.0	3.6	5.9	2.0
Labour	3.2	3.5	3.0	5.2	1.5
Energy	8.5	13.4	4.5	7.2	2.7
Materials	4.6	4.5	4.8	2.1	6.6
Services	7.1	8.4	6.1	7.4	5.2
TFP	2.1	3.6	0.9	0.2	1.4

B Average annual growth in input productivities and TFP in the utility industry, Canada, 1962-88

	1962-88	1962-73	1974-88	1974-79	1980-88
	(Average annual per cent change)				
TFP	2.1	3.6	0.9	0.2	1.4
Input productivities					
Capital	2.1	3.6	0.9	–0.2	1.6
Labour	3.5	5.5	1.8	1.3	2.2
Energy	–0.4	–2.7	1.5	1.0	1.8
Materials	2.2	4.9	–0.0	3.8	–2.6
Services	–0.3	0.5	–0.9	–1.3	–0.6

Source Estimates by the authors, based on data from Statistics Canada.

the agriculture industry. The sector's productivity increased by only 0.6 per cent per year in the post-1973 period, a slowdown of 4.7 percentage points from the earlier period. In sharp contrast, the U.S. industry's productivity growth increased to 5.6 per cent per year. The trends in unit labour costs and the value-added deflator in the two countries are consistent with the productivity trends, suggesting a marked deterioration in the competitive position of the Canadian farm sector vis-à-vis its U.S. counterpart, even after taking into account the favourable effect of the large depreciation of the Canadian dollar during this period. Moreover, the large appreciation of the Canadian dollar since 1986 will have exacerbated its competitive problems.

Table 18

A Average annual growth in output, inputs, and TFP in the transportation, storage, and communications industry, Canada, 1962-88

	1962-88	1962-73	1974-88	1974-79	1980-88
	(Average annual per cent change)				
Gross output	5.7	7.1	4.6	5.9	3.7
Inputs	2.9	3.6	2.4	3.3	1.8
Capital	2.2	2.5	1.9	1.7	2.0
Labour	1.5	1.8	1.2	2.7	0.2
Energy	3.1	6.6	0.3	2.7	–1.3
Materials	4.2	4.6	3.8	4.3	3.5
Services	6.5	8.2	5.1	6.2	4.4
TFP	2.8	3.5	2.2	2.6	1.9

B Average annual growth in input productivities and TFP in the transportation, storage, and communications industry, Canada, 1962-88

	1962-88	1962-73	1974-88	1974-79	1980-88
	(Average annual per cent change)				
TFP	2.8	3.5	2.2	2.6	1.9
Input productivities					
Capital	3.5	4.4	2.7	4.2	1.8
Labour	4.2	5.2	3.3	3.2	3.5
Energy	2.8	0.6	4.6	3.4	5.4
Materials	1.5	2.4	0.8	1.6	0.2
Services	–0.7	–1.0	–0.4	–0.1	–0.6

Source Estimates by the authors, based on data from Statistics Canada.

Table 19

A Average annual growth in output, inputs, and TFP in the wholesale and retail trade industry, Canada, 1962-88

	1962-88	1962-73	1974-88	1974-79	1980-88
	(Average annual per cent change)				
Gross output	4.6	5.5	3.9	3.3	4.2
Inputs	3.1	3.3	3.0	3.2	2.8
Capital	1.3	0.5	2.0	1.1	2.6
Labour	3.2	3.7	2.8	3.4	2.4
Energy	2.3	5.6	–0.3	4.8	–3.8
Materials	2.2	2.6	2.0	1.8	2.1
Services	5.7	5.8	5.6	5.9	5.4
TFP	1.5	2.2	0.9	0.1	1.4

B Average annual growth in input productivities and TFP in the wholesale and retail trade industry, Canada, 1962-88

	1962-88	1962-73	1974-88	1974-79	1980-88
	(Average annual per cent change)				
TFP	1.5	2.2	0.9	0.1	1.4
Input productivities					
Capital	3.2	4.9	1.9	2.2	1.6
Labour	1.4	1.7	1.1	0.0	1.8
Energy	3.6	0.2	6.3	–1.1	11.3
Materials	2.4	2.9	1.9	1.6	2.1
Services	–1.0	–0.3	–1.6	–2.4	–1.1

Source Estimates by the authors, based on data from Statistics Canada.

Mining

Over the last 30 years, the Canadian mining industry has been an important contributor to the narrowing of the gap between Canada and the United States in aggregate labour productivity.[10] Its labour productivity increased by about 1.6 per cent per year between 1962 and 1986, compared to a small increase of less than 0.1 per cent per year in the United States. Labour productivity fell during the 1974-86 period in both Canada and the United States.

The decline in labour productivity growth, in combination with a sharp increase in hourly compensation, dramatically increased (over 10.0 per cent per year) the growth of mining industry unit labour costs in the two countries in the post-1973 period. However, most of the increase occurred in the first

Table 20

A Average annual growth in output, inputs, and TFP in the finance, insurance, and real estate industry, Canada, 1962-88

	1962-88	1962-73	1974-88	1974-79	1980-88
	(Average annual per cent change)				
Gross output	5.5	5.9	5.2	6.0	4.6
Inputs	6.4	6.6	6.4	6.8	6.0
Capital	9.2	9.4	9.0	10.2	8.2
Labour	4.4	5.0	3.8	4.9	3.1
Energy	7.8	13.0	3.7	4.1	3.4
Materials	5.2	5.4	5.1	3.6	6.2
Services	8.0	7.8	8.2	8.0	8.3
TFP	–0.9	–0.7	–1.2	–0.8	–1.4

B Average annual growth in input productivities and TFP in the finance, insurance, and real estate industry, Canada, 1962-88

	1962-88	1962-73	1974-88	1974-79	1980-88
	(Average annual per cent change)				
TFP	–0.9	–0.7	–1.2	–0.8	–1.4
Input productivities					
Capital	–3.4	–3.2	–3.5	–3.8	–3.3
Labour	1.1	0.8	1.3	1.0	1.5
Energy	–1.8	–6.2	1.6	1.9	1.5
Materials	1.0	1.7	0.4	2.4	–0.9
Services	–2.3	–1.7	–2.7	–1.8	–3.3

Source Estimates by the authors, based on data from Statistics Canada.

part of this period – unit labour cost growth reached almost 20 per cent in both countries. In the 1980-86 period, unit labour cost growth was much lower but not as low as growth in the value-added deflators. This implies that capital costs for the industries were declining or, more likely, that profit margins were being squeezed as international mineral prices fell.

The better productivity and cost performance of the Canadian mining industry over the 1962-86 period, in conjunction with the depreciation of the Canadian dollar up to 1986, implies that the Canadian industry was quite competitive vis-à-vis its U.S. counterpart. Assuming that the 1980-86 trends in the value-added deflator remain unchanged, then the 20-per-cent appreciation of the Canadian dollar, between 1986 and 1991, implies a modest de-

terioration in the competitive position of the Canadian mining industry during the last few years.

Construction

The Canadian construction industry also contributed to the narrowing of the Canada-U.S. aggregate labour productivity gap during the 1962-86 period. In Canada, the industry's labour productivity increased by 1.5 per cent per year between 1962 and 1986, compared to a 1.7-per-cent per year decline in the United States. However, it is important to point out that the steady fall

Table 21

A Average annual growth in output, inputs, and TFP in the community, business, and personal services industry, Canada, 1962-88

	1962-88	1962-73	1974-88	1974-79	1980-88
	(Average annual per cent change)				
Gross output	5.8	6.3	5.3	5.8	5.0
Inputs	5.9	6.5	5.4	5.5	5.4
Capital	6.8	8.3	5.6	3.3	7.2
Labour	5.9	6.3	5.6	6.1	5.2
Energy	5.2	10.2	1.1	4.6	–1.2
Materials	3.9	4.3	3.6	4.4	3.1
Services	7.0	6.9	7.1	7.7	6.7
TFP	–0.1	–0.2	–0.1	0.3	–0.4

B Average annual growth in input productivities and TFP in the community, business, and personal services industry, Canada, 1962-88

	1962-88	1962-73	1974-88	1974-79	1980-88
	(Average annual per cent change)				
TFP	–0.1	–0.2	–0.1	0.3	–0.4
Input productivities					
Capital	–0.9	–1.7	–0.2	2.5	–2.1
Labour	–0.1	0.1	–0.2	–0.2	–0.2
Energy	1.5	–3.4	5.3	1.3	8.1
Materials	1.8	1.9	1.8	1.5	2.0
Services	–1.1	–0.5	–1.6	–1.7	–1.6

Source: Estimates by the authors, based on data from Statistics Canada.

Table 22

Annual growth in labour productivity, nonmanufacturing industries, Canada and the United States, 1962-86

	1962-73		1974-86		1974-79		1980-86	
	Canada	United States	Canada	United States	Canada	United States	Canada	United States
	(Compounded annual per cent change)							
Farming[1]	5.3	4.3	0.6	5.6	–2.3	3.1	3.1	7.8
Mining	5.6	3.1	–2.0	–2.7	–4.6	–7.7	0.3	1.8
Construction	0.3	–2.2	2.5	–1.3	2.6	–1.7	2.5	–0.9
Utilities	5.4	4.5	1.7	–0.3	0.9	–1.3	2.4	0.5
Transportation, storage, and communications	5.5	3.5	3.6	1.8	4.0	2.0	3.3	1.6
Wholesale and retail trade	2.1	3.3	0.6	2.5	–0.5	1.7	1.6	3.2
Finance, insurance, and real estate	0.3	1.4	0.6	–0.6	0.8	0.5	0.4	–1.6
Community, business, and personal services	0.2	2.6	–0.5	–0.1	–0.3	0.1	–0.7	–0.3

1 Includes agriculture, fishing, and forestry.

Source Estimates by the authors, based on data from Statistics Canada and the U.S. Department of Labor.

in the U.S. construction industry's productivity has puzzled productivity experts for a long time.[11]

The substantial increase of 2.5 per cent per year in Canadian construction industry labour productivity during the 1974-86 period, compared to a reduction of 1.3 per cent in the U.S. industry, is reflected in the growth of both unit labour costs and the value-added deflator. The similarity of the trends in these two measures, in both Canada and the United States, reflects the fact that capital inputs are relatively unimportant in this industry.

Utilities

Labour productivity in the utilities industry grew at a healthy pace in both Canada and the United States during the pre-1973 period. But its growth slowed substantially in the 1974-86 period in both countries. However, Canadian growth was always higher so that, like mining and construction, this industry also contributed to the narrowing of the aggregate labour productivity gap with the United States in the postwar period. Labour productivity in the Canadian industry increased by about 1.5 percentage point faster per year than its U.S. counterpart over the 1962-86 period.

Despite superior productivity performance, the Canadian industry experienced larger increases in unit labour costs and the value-added price during the 1974-86 period. Canada's value-added price rose much faster – 10.1 per cent growth per year compared to 8.8 per cent growth in the United States. Faster growth in Canadian input prices was the cause of these differences.

Transportation, Storage, and Communications

Labour productivity in Canada in this industry increased at a substantially faster pace than in the United States. As a result, this industry contributed a great deal towards the narrowing of the Canada-U.S. aggregate labour productivity gap. Over the whole 1962-86 period, Canada's productivity growth was almost 2.0 percentage points faster per year than in the United States.

However, the much stronger Canadian productivity performance did little to improve the industry's cost competitive position during the 1974-86 period. Its value-added deflator increased by 5.7 per cent per year during this period, compared to a 6.1-per-cent annual growth rate in the United States. A similar trend occurred in unit labour costs, implying a faster growth in Canadian hourly compensation, although this was more than offset by the depreciation of the Canadian dollar in this period. Since 1986, the appreciation of the Canadian currency has likely worsened the industry's cost competitiveness, especially if labour costs have continued to increase faster than in the United States.

Table 23

Annual growth in unit labour costs, nonmanufacturing industries, Canada and the United States, 1962-86

	1962-73		1974-86		1974-79		1980-86	
	Canada	United States	Canada	United States	Canada	United States	Canada	United States
	(Compounded annual per cent change)							
Farming[1]	2.8	2.9	7.1	–0.5	12.2	5.9	2.9	–7.5
Mining	1.4	2.6	13.2	11.4	19.5	18.6	8.1	3.6
Construction	7.1	8.3	5.6	8.3	6.8	10.6	4.5	5.5
Utilities	0.6	1.1	8.1	7.6	11.9	9.3	4.9	5.6
Transportation, storage, and communications	1.4	2.7	5.7	6.0	7.1	7.8	4.5	4.0
Wholesale and retail trade	3.8	2.6	7.5	5.7	10.6	8.3	4.9	2.7
Finance, insurance, and real estate	5.8	4.3	8.9	9.1	10.0	9.2	7.9	8.9
Community, business, and personal services	5.8	3.9	8.7	7.5	10.2	8.4	7.3	5.8

1 Includes agriculture, fishing, and forestry.

Source Estimates by the authors, based on data from Statistics Canada and the U.S. Department of Labor.

Wholesale and Retail Trade

In contrast to the good productivity performance of the preceding four Canadian nonmanufacturing industries, the labour productivity of the wholesale and retail trade industry lagged behind its U.S. counterpart during the 1962-86 period. Canadian productivity increased by only about 1.3 per cent per year during the 1962-86 period, compared to a 2.9-per-cent annual increase in the U.S. industry.

The weaker productivity performance of the Canadian industry, in combination with faster growth in input prices, substantially worsened its cost/price performance in relation to the U.S. industry during the 1974-86 period. Its value-added deflator increased by 7.5 per cent annually during this period, compared to 5.9 per cent in the United States.

Finance, Insurance, and Real Estate

The labour productivity performance of this industry was quite poor in both Canada and the United States. The United States did better in the 1962-73 period while Canada did better in the 1974-86 period. As a result, labour productivity growth was virtually the same in the two countries over the 1962-86 period.

Despite the better Canadian productivity performance during the 1974-86 period, unit labour costs and the value-added deflator increased at roughly the same pace as in the United States because of a larger increase in Canadian input prices. For instance, the value-added deflator in Canada increased at an annual rate of 8.0 per cent, compared to 7.8 per cent in the United States.

Community, Business, and Personal Services

As in the wholesale and retail trade industry, productivity growth in this Canadian industry lagged behind its U.S. counterpart in the years between 1962 and 1986. Labour productivity increased by 2.6 per cent per year in the U.S. industry compared to only 0.2 per cent per year in the Canadian industry during the 1962-73 period. In the second period, the United States experienced a much larger slowdown and, as in Canada, productivity fell.

Because of the much poorer productivity performance and a higher increase in Canadian wages and salaries, unit labour costs in the Canadian industry increased by 1.2 percentage point per year faster than in the U.S. industry during the 1974-86 period. However, in terms of the value-added deflator, the Canadian performance was very similar to the U.S. record, suggesting a slightly larger increase in the U.S. industry's capital costs, or an expansion of their profit margins.

Table 24

Annual growth in the value-added deflator, nonmanufacturing industries, Canada and the United States, 1962-86

	1962-73		1974-86		1974-79		1980-86	
	Canada	United States	Canada	United States	Canada	United States	Canada	United States
	(Compounded annual per cent change)							
Farming[1]	6.4	7.9	5.4	–0.6	11.6	1.3	0.3	2.7
Mining	2.8	2.8	11.0	11.3	22.7	24.0	1.8	–1.8
Construction	7.3	8.6	6.2	8.4	7.8	10.9	6.7	5.6
Utilities	0.2	0.9	10.1	8.8	12.4	9.3	8.1	8.3
Transportation, storage, and communications	1.4	2.6	5.7	6.1	6.4	7.1	5.2	5.0
Wholesale and retail trade	3.2	3.2	7.5	5.9	9.9	7.9	5.5	3.6
Finance, insurance, and real estate	3.9	3.5	8.0	7.8	7.8	7.8	8.1	7.7
Community, business, and personal services	5.1	4.0	7.7	7.4	8.8	8.3	6.8	6.5

1 Includes agriculture, fishing, and forestry.

Source: Estimates by the authors, based on data from Statistics Canada and the U.S. Department of Labor.

Summary

The Canadian productivity performance was substantially better than the U.S. record in the transportation, storage, and communications, construction, utilities, and mining industries during the 1962-86 period – these industries were largely responsible for the narrowing of the aggregate Canada-U.S. labour productivity gap during the postwar period. On the other hand, the U.S. record in the service sectors and in farming (mainly agriculture) was generally better.

The cost/price competitiveness of the Canadian farm sector vis-à-vis the U.S. deteriorated dramatically during the 1974-86 period. This is especially significant given that, of all the nonmanufacturing industries (with the exception of mining), it is the farming sector which most directly competes with its U.S. counterpart both at home and abroad. Thus the relative competitiveness of this industry will have a major impact on Canada's nonmanufacturing trade.

Canada significantly improved its relative cost/price performance in construction and mining. The relative price position of the other Canadian nonmanufacturing industries deteriorated somewhat during this period. However, the exchange-rate depreciation of the 1974-86 period ensured that all of the Canadian nonmanufacturing industries (with the exception of farming) remained competitive with the U.S. industries, often substantially more so. The rapid appreciation of recent years will have changed this unless the Canadian industries have been able to compensate by faster improvements in their relative costs and productivity.

Conclusions

The main objective of this paper has been to analyse the production process and cost performance of Canadian industries during the period 1962-88, and compare the Canadian developments with the trends in the United States. In this final section, we highlight the main findings of the study and point out some of the policy implications of our results.

Pervasive Output and Productivity Growth Problems

Output growth declined dramatically during the post-1973 period, compared to the performance in the 1960s and the early 1970s, in almost all the Canadian manufacturing and nonmanufacturing industries. Consequently, the

growth rate of Canadian real GDP declined from 5.9 per cent per year during the period 1962-73 to 3.6 per cent per year in the 1974-88 period.

A slowdown in sectoral TFP growth rates played a major role in the slowdown of GDP growth. Our results suggest that a substantial part (about 80 per cent) of the slowdown in GDP growth between the periods 1962-73 and 1974-88 was *directly* caused by the slowdown in sectoral TFP growth rates. The remaining slowdown in GDP growth was due to a reduction in employment growth. The slowdown in sectoral TFP was also the primary cause of the poor performance of aggregate labour productivity in the post-1973 period.

The pervasiveness of these trends in output and TFP across industries suggests that, in general, industry specific factors are not the chief cause of the declining productivity performance. This conclusion is reinforced by the fact that TFP growth also slowed dramatically in almost all U.S. manufacturing industries although, on average, the TFP slowdown was less pronounced than in Canada.

Although problems with TFP have been pervasive, the trends in the productivity of individual inputs varied. In Canada, capital and labour productivities experienced a declining trend over the 1974-88 period, but the productivities of other inputs (energy, materials, and purchased service inputs) did not.

Capital Accumulation Not a Major Problem

Our results indicate that insufficient capital accumulation, on average, played only a small role in the productivity slowdown in Canada. In fact, the problem has more to do with the efficiency with which capital is used, rather than a lack of capital. Capital inputs increased more than most other inputs in many industries. However, our analysis does not capture the impact on aggregate productivity performance of changes in either the quality of capital or its allocation across industries.

TFP: An Important Determinant of Cost Trends

The growth of unit costs accelerated substantially in all the Canadian industrial sectors during the post-1973 period, especially in the 1974-79 period. The reduction in TFP growth *directly* accounted for an average of about 25 to 30 per cent of the increase in the growth rate of unit costs in Canada. But,

its total contribution to the inflation problems of the post-1973 period was likely much larger, because of the indirect adverse effects which a TFP slowdown would have on factor prices, especially intermediate input prices.

More importantly, our findings strongly indicate that the trends in relative unit costs across industries in Canada and the United States during the 1974-88 period were mainly influenced by the relative growth rates in TFP across industries because trends in input price inflation tended to be fairly similar across industries. Since relative price trends influence trade patterns, it is clear that addressing the TFP slowdown will have important implications for Canada's trade performance.

Ability to Adjust Is Important

Our detailed examination of the trends in the production process of the Canadian and U.S. industries strongly suggests that the degree and the speed with which an industry adjusts its input mix to changes in relative input prices, plays a crucial role in its relative productivity and cost performance. In the post-1973 period, those industries where the adjustment in the input mix in response to the two energy price shocks was relatively fast and strong tended to have relatively better TFP and cost performance (see Tables 25 and 26).

In many of the Canadian manufacturing industries the adjustment in input mix to the two energy price shocks was slower and weaker than in their U.S. counterparts. Figures 7 and 8 show that the Canadian manufacturing sector reduced its energy/output ratio much more slowly than did the U.S. sector after the energy price shocks. The Canadian government policy of keeping energy prices below world price levels delayed and weakened the adjustment in Canadian industries and contributed to their poor productivity and cost/price performance during the 1974-88 period [see Rao and Lemprière 1992*a*].

Canada-U.S. Competitiveness

The relative trends in costs and prices shown in this paper imply that the Canadian manufacturing sector, on average, remained competitive in relation to the U.S. sector during the 1974-88 period, once exchange-rate movements are taken into account. However, its position during the 1986-91 period deteriorated substantially – the exchange rate appreciated significantly and it is likely that Canadian cost growth continued to be higher than in the United States. What is especially worrying is that, while TFP growth in many U.S. manufacturing industries rebounded significantly after a sharp slowdown in 1974-79, this did not occur in Canada. Instead, TFP in many cases continued to decline in the 1980-88 period after the 1974-79 slowdown.

Table 25

Average annual growth in the energy/output ratio, total factor productivity, and total unit costs, Canadian business-sector industries, 1974-88

	Energy/ output ratio growth 1974-79	Energy/ output ratio growth 1974-88	Total factor productivity growth 1974-88	Total unit cost growth 1974-88
	(Average annual per cent change)			
Food and beverages	-0.4	-1.6	0.0	6.9
Paper and allied products	2.4	0.1	-0.1	9.5
Primary metal products	0.9	-1.1	0.4	8.8
Wood products	0.6	-1.5	1.4	5.4
Chemicals	4.8	-0.3	0.4	9.2
Nonelectrical machinery	-0.7	0.1	-0.2	8.3
Electrical products	-2.6	-4.6	2.3	3.7
Transportation equipment	-3.0	-1.6	0.1	7.7
Nonmetallic mineral products	1.2	-1.0	0.5	8.6
Fabricated metal products	0.3	0.3	0.1	7.8
Furniture and fixtures	-0.1	0.7	-0.5	8.0
Textiles and clothing	-2.2	-1.8	1.4	6.0
Printing and publishing	-3.1	-1.4	0.4	7.9
Tobacco	-1.3	-0.8	0.1	8.7
Rubber and plastics	-0.6	-0.4	0.9	7.6
Petroleum refining	-0.1	-0.5	0.2	13.2
Miscellaneous manufacturing	-2.8	-0.8	-0.1	7.7
Agriculture	-0.3	-3.0	0.5	5.5
Fishing	5.7	-3.3	1.2	8.8
Forestry	-3.7	-2.9	2.2	7.1
Mining	4.3	0.8	-1.5	9.9
Construction	0.2	-3.1	0.6	7.3
Transportation, storage, and communications	-3.0	-4.1	2.2	6.1
Utilities	1.4	0.0	0.9	9.2
Wholesale and retail trade	1.5	-4.0	0.9	7.1
Finance, insurance, and real estate	-1.7	-1.4	-1.2	7.8
Community, business, and personal services	-1.1	-3.9	-0.1	7.4

NOTE The correlation between growth in TFP (column 3) and growth in the energy/output ratio (column 2) is -0.70. The correlation between changes in unit costs (column 4) and growth in the energy/output ratio (column 2) is 0.61.

SOURCE Estimates by the authors, based on data from Statistics Canada.

The Canadian labour productivity performance was substantially better than the U.S. record in the transportation, storage, and communications, construc-

Table 26

Average annual growth in the energy/output ratio, total factor productivity, and total unit costs, United States manufacturing industries, 1974-88

	Energy/ output ratio growth 1974-79	Energy/ output ratio growth 1974-88	Total factor productivity growth 1974-88	Total unit cost growth 1974-88
	(Average annual per cent change)			
Food and beverages	-3.0	-1.9	0.3	4.6
Paper and allied products	0.2	-1.5	0.6	7.3
Primary metal products	2.1	0.2	-0.4	7.6
Wood products	-3.5	-2.3	0.8	4.7
Chemicals	-0.9	-2.4	0.5	7.6
Nonelectrical machinery	-4.7	-5.1	2.4	2.4
Electrical products	-4.6	-3.8	1.8	4.6
Transportation equipment	-2.3	-1.4	0.4	6.3
Nonmetallic mineral products	-1.5	-1.9	0.2	6.7
Fabricated metal products	-2.5	-0.6	0.5	6.5
Furniture and fixtures	-3.0	-0.6	0.4	5.9
Textiles and clothing	-3.3	-2.1	0.9	4.1
Printing and publishing	-3.9	-0.3	-0.3	7.0
Tobacco	3.2	2.8	-1.7	10.2
Rubber and plastics	-0.4	-0.3	0.8	6.3
Petroleum refining	-2.7	-1.5	-0.3	11.6
Miscellaneous manufacturing	-3.6	0.8	0.8	5.5

Note: The correlation between growth in TFP (column 3) and growth in the energy/output ratio (column 2) is -0.82. The correlation between changes in unit costs (column 4) and growth in the energy/output ratio (column 2) is 0.60.

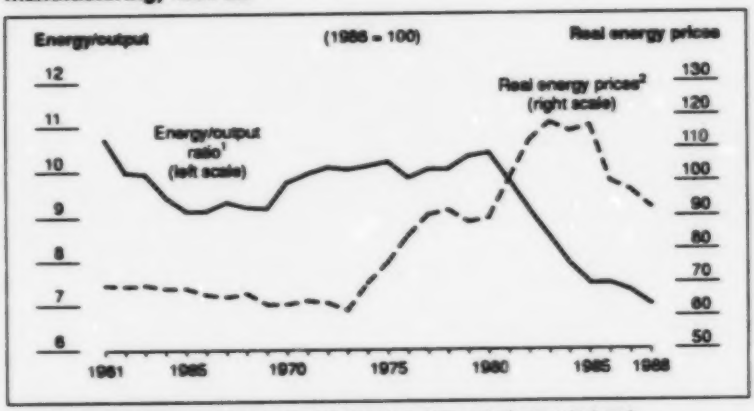
Source: Estimates by the authors, based on data from the U.S. Department of Labor.

tion, mining, and utilities industries during the 1961-86 period. These industries made important contributions to the narrowing of the aggregate Canada-U.S. labour productivity gap during the postwar period. On the other hand, the United States generally improved its relative productivity performance in farming and the overall service sector.

Like the manufacturing industries, the Canadian nonmanufacturing industries, with the exception of farming, improved their cost competitiveness vis-à-vis their U.S. counterparts during the 1974-86 period, when the exchange rate depreciation is taken into account. But, as with the manufacturing sector, the nonmanufacturing industries will also have lost competitive position due to the large appreciation of the past few years.

Figure 7

Canadian real energy prices and energy/output ratio, manufacturing, 1961-88

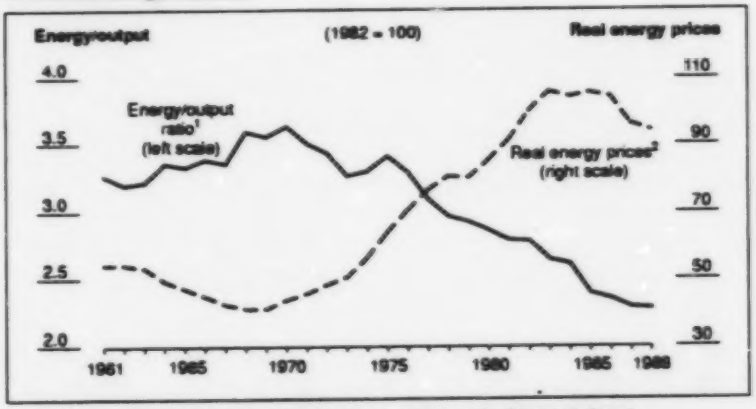


1 The energy/output ratio is the energy (volume) used per unit of output (volume).
2 The real energy price index is the weighted sum of real indexes for individual manufacturing industries. The real energy price is derived as the energy input price relative to the gross output price.

Source Estimates by the authors, based on data from Statistics Canada.

Figure 8

United States real energy prices and energy/output ratio, manufacturing, 1961-88



1 The energy/output ratio is the energy (volume) used per unit of output (volume).
2 The real energy price index is the weighted sum of real indexes for individual manufacturing industries. The real energy price is derived as the energy input price relative to the gross output price.

Source Estimates by the authors, based on data from the U.S. Department of Labor.

Policy Implications

The poor performance of the Canadian economy during the post-1973 period – sluggish growth in real wages, increasing unemployment and accelerating inflation – was caused in large part either directly or indirectly by the drop in sector TFP growth rates. Therefore, Canada's economic outlook critically depends upon the efficacy with which business, labour, and policymakers address the problem of the total factor productivity growth slowdown.

The recent deterioration in the competitive position of Canadian industries in relation to their U.S. competitors as a result of the large appreciation of the Canadian dollar, faster growth in input prices, and slower productivity growth, does not bode well for the future. These cost/price trends in combination with the gradual removal of tariff and nontariff barriers in the two countries, under the FTA, imply substantial adjustment difficulties during the short-to-medium term, unless there is a dramatic improvement in their relative productivity and cost performance and/or the exchange rate depreciates significantly. The creation of a North American Free Trade Area could add to these difficulties.

Public policy must attempt to address the question of why Canadian productivity growth has slowed and, in particular, why Canada's performance has been weaker than that of the United States. Policies which efficiently encourage productivity improvements and increase wage-price flexibility must be devised. In Rao and Lemprière [1992*a*] we go beyond the analysis here to ascertain more precisely what determines productivity growth and why it has slowed.

However, our principal findings outlined above have a number of important implications with respect to policies for productivity enhancement. First, it is especially clear that sector specific policy initiatives and incentives will not adequately address the productivity slowdown problem. The difficulties appear to be too pervasive to have their origins in the characteristics of individual industries, even very important ones. A second lesson to be derived is that investment stimulating incentives will not provide a solution since, as noted, capital accumulation has not been much of a problem. A third very important lesson is that policy should attempt to avoid interfering with the process of adjustment to price shocks. Although a short-term advantage may be gained by endeavouring to protect industries from such shocks, the long-term consequences may be negative.

Addressing the problems with productivity growth can only be a long-term endeavour. In the near term, it is unlikely that improvements in Canada's cost competitive position can result solely from improvements in relative productivity and cost performance.

Therefore public policymakers must address the serious problem of the high exchange rate and its principal cause, high interest rates. A change in the Canadian fiscal and monetary policy mix which facilitates a fall in the exchange rate while, at the same time, not adding to inflationary pressures is required. A simple reduction in Canadian interest rates would be counterproductive because it would cause heightened inflation and thus would not improve the competitive position of Canada's manufacturing sector. Instead, what is required is tighter fiscal policy. By addressing the budget deficit problem, this would simultaneously allow interest rates to fall and improve Canada's competitive position, while not adding to inflation [see Economic Council of Canada 1989, 1992].

A TFP and Cost Performance of Major Canadian Manufacturing Industries

Appendix A gives detailed data on the trends in TFP, input prices and costs, input mix, input productivities, output, and output price in eight major manufacturing industries. Data for their U.S. counterparts are also given for comparative purposes. The industries are food and beverages; paper and allied products; wood products; primary metal products; transportation equipment; chemical products; electrical machinery; and nonelectrical machinery.

In the Canadian manufacturing sector, these industries account for about 70 per cent of the total value-added, about 60 per cent of total employment, and almost 90 per cent of total exports (see Table A-1). Thus their productivity and cost performance strongly influences the overall output, employment, price, and competitive performance of the Canadian manufacturing sector. And, because manufacturing products account for most of Canada's trade, these industries also greatly influence Canada's trade balance, real incomes, and general economic health.

Table A-1

Indicators of the importance of the eight major Canadian manufacturing industries, 1988

	Share in manufacturing value-added	Share in manufacturing employment	Share in manufacturing exports	Proportion of output exported
	(Per cent)			
Food and beverages	12.7	11.9	5.0	13.5
Paper and allied products	8.6	6.2	14.1	59.5
Primary metal products	7.7	5.5	9.6	36.9
Wood products	5.6	6.4	6.1	43.5
Chemicals	7.4	4.8	5.7	26.3
Nonelectrical machinery	4.0	4.7	4.9	51.2
Electrical products	8.1	7.7	6.9	39.1
Transportation equipment	13.8	12.0	35.5	72.0

Source: Estimates by the authors, based on data from Statistics Canada and Industry, Science and Technology Canada.

Food and Beverage Industry

The output growth rate of the Canadian food and beverage industry declined from 3.7 per cent per year during the 1962-73 period to 1.9 per cent in the 1974-88 period. The slowdown in TFP directly accounted for almost 55 per cent of this decline although a large part was also likely caused by the indirect effect of the TFP slowdown on input growth. Similarly, the slowdown in TFP growth accounted for almost 60 per cent of the reduction in labour productivity growth. The rest of the labour productivity slowdown was due to the slower growth of nonlabour inputs relative to the growth of the labour input (see Tables A-2 and A-3).

In Canada, total unit costs (gross output price) of the industry increased at an average annual rate of 6.9 per cent per year during the 1974-88 period, compared to 4.2 per cent in the first period (1962-73). The slowdown in TFP directly accounted for almost 40 per cent of this acceleration in price inflation with the rest resulting from faster growth in input prices. The acceleration in input price inflation can be largely attributed to the adverse effects (direct and indirect) of the two energy price shocks on factor prices and productivity growth in Canada.

Canada-U.S. Comparisons

In sharp contrast to the poor performance of the Canadian industry, the food and beverage industry in the United States experienced much less of a slowdown in its output, TFP, and labour productivity growth during the post-1973 period (see Tables A-2 and A-3). In addition, TFP growth in the U.S. industry rebounded sharply in 1980-88 to return almost to its pre-1973 level. In contrast, Canadian TFP growth declined significantly in the 1974-79 period and stopped altogether in the 1980-88 period. Until the end of the 1970s, the Canadian TFP performance was slightly better than that of the United States, but in the 1980-88 period, Canada did much worse. Overall, TFP growth was equal in the two countries in the 1962-88 period.

The response of the input mix to the two energy price shocks of the 1970s was slower and weaker in Canada than in the United States. In Canada, the energy/output ratio (the inverse of energy/input productivity) declined at a much slower pace during the 1974-79 period than in the 1962-73 period. In contrast, the U.S. industry experienced an increase in its energy/output ratio in the 1962-73 period, followed by a substantial decline in the 1974-79 period. Some of the weak adjustment in Canada may be directly attributable to the federal government's decision to insulate the Canadian industries from the adverse effects of higher OPEC oil prices, by keeping energy prices in Canada below the world price level.

Table A-2

Average annual growth in output, inputs, and TFP in the food and beverage industry, Canada-U.S. comparisons, 1962-88

	Canada					United States				
	1962-88	1962-73	1974-88	1974-79	1980-88	1962-88	1962-73	1974-88	1974-79	1980-88
	(Average annual per cent change)									
Gross output	2.7	3.7	1.9	2.4	1.5	2.3	2.5	2.2	2.6	1.9
Inputs	2.2	2.7	1.9	2.1	1.8	1.8	1.7	1.9	2.7	1.3
Capital	2.4	3.1	1.8	1.3	2.2	1.9	1.7	2.0	3.2	1.2
Labour	0.4	0.5	0.3	0.5	0.1	-0.4	-0.4	-0.4	-0.1	-0.6
Energy	1.3	2.7	0.2	2.0	-1.0	2.2	4.8	0.2	-0.5	0.7
Materials	2.8	3.5	2.2	2.8	1.8	2.3	2.3	2.3	3.1	1.8
Services	3.0	3.3	2.8	3.1	2.7	3.3	2.0	4.4	5.1	4.0
TFP	0.5	1.0	0.0	0.3	-0.1	0.5	0.8	0.3	-0.1	0.6

Source: Estimates by the authors, based on data from Statistics Canada and the U.S. Department of Labor.

Table A-3

Average annual growth in input productivities and TFP in the food and beverage industry, Canada-U.S. comparisons, 1962-88

	Canada					United States				
	1962-88	1962-73	1974-88	1974-79	1980-88	1962-88	1962-73	1974-88	1974-79	1980-88
	(Average annual per cent change)									
TFP	0.5	1.0	0.0	0.3	–0.1	0.5	0.8	0.3	–0.1	0.8
Input productivities										
Capital	0.3	0.6	0.1	1.2	–0.7	0.4	0.7	0.2	–0.6	0.7
Labour	2.3	3.3	1.6	1.9	1.4	2.7	2.9	2.6	2.7	2.5
Energy	1.6	1.3	1.9	0.5	2.7	0.5	–1.6	2.1	3.3	1.3
Materials	–0.1	0.2	–0.3	–0.3	–0.3	0.0	0.2	–0.1	–0.7	0.3
Services	–0.3	0.5	–0.9	–0.6	–1.1	–0.8	0.6	–1.9	–2.4	–1.7

Source Estimates by the authors, based on data from Statistics Canada and the U.S. Department of Labor.

Despite a sharp increase in the relative price of energy, the acceleration of input price inflation in the United States was minimal in the post-1973 period. This moderate increase, in conjunction with a relatively small reduction in TFP growth, contributed to the good cost and price performance of the U.S. industry during the 1974-88 period (see Tables A-4 and A-5). Its output price increased by 4.6 per cent per year in the second period, compared to a 4.0 per cent increase in the first period.

The experience of the Canadian food and beverage industry was not so favourable. Its output price increased at a much faster pace than did in the United States during the 1974-88 period. Consequently, the cumulative increase in the Canadian price relative to the U.S. price was substantially larger than the reduction in the value of the Canadian dollar vis-à-vis the U.S. currency in the 1974-88 period. The result was a significant deterioration in the competitive position of the Canadian industry. The large increase in the value of the Canadian dollar since 1986 (about 20 per cent), and the recent trends (1980-88) in the unit costs, indicate that the cost competitiveness of the Canadian industry has likely worsened considerably (about 35 per cent) during the last few years.

Paper and Allied Products Industry

The output of the paper industry declined dramatically in the post-1973 period in both Canada and in the United States (see Table A-6). In Canada, TFP directly accounted for about 30 per cent of the output slowdown, with the total effect likely being much larger due to the indirect effect of slower TFP growth on input growth and, hence, on industry output growth.

Labour productivity growth in the Canadian industry averaged 2.9 per cent per year during the 1962-73 period, compared to its TFP growth of only 0.6 per cent (see Table A-6). Thus the faster growth of nonlabour inputs relative to the growth of labour, induced by changes in relative input prices, contributed substantially to the growth in labour productivity during this period. However, the slowdown in TFP growth accounted for all of the slowdown in labour productivity growth between the two periods (see Tables A-6 to A-8).

The cost and price performance of the Canadian industry deteriorated dramatically during the 1974-88 period, especially during 1974-79 (see Tables A-8 and A-9). The acceleration in input price inflation directly accounted for over 80 per cent of the increase in output price inflation, with the rest due to the slowdown in TFP growth (see Table A-8).

Table A-4

Average annual growth in output price, input prices, and TFP in the food and beverage industry, Canada-U.S. comparisons, 1962-88

	Canada					United States				
	1962-88	1962-73	1974-88	1974-79	1980-88	1962-88	1962-73	1974-88	1974-79	1980-88
	(Average annual per cent change)									
Gross output price	5.7	4.2	6.9	10.0	4.8	4.4	4.0	4.6	7.5	2.7
Input prices	6.2	5.2	6.9	10.3	4.7	4.9	4.8	4.9	7.4	3.3
Capital[1]	7.0	5.2	8.5	9.1	8.1	7.2	2.2	11.2	13.7	9.5
Labour	8.1	6.6	9.2	12.2	7.2	6.6	5.6	7.4	9.8	5.8
Energy	7.1	2.0	11.3	17.5	7.2	7.0	1.6	11.3	20.3	5.3
Materials	5.5	4.9	5.9	10.0	3.2	4.2	4.9	3.8	6.4	2.0
Services	5.4	3.4	7.0	9.0	5.6	5.3	3.4	6.8	7.7	6.2
TFP	0.5	1.0	0.0	0.3	–0.1	0.5	0.8	0.3	–0.1	0.6

1 Variations in the price of capital include variations in profit margins.

Source Estimates by the authors, based on data from Statistics Canada and the U.S. Department of Labor.

Table A-5

Average annual growth in output price and input costs in the food and beverage industry, Canada-U.S. comparisons, 1962-88

	Canada					United States				
	1962-88	1962-73	1974-88	1974-79	1980-88	1962-88	1962-73	1974-88	1974-79	1980-88
	(Average annual per cent change)									
Gross output price	5.7	4.2	6.9	10.0	4.8	4.4	4.0	4.6	7.5	2.7
Input costs	5.7	4.2	6.9	10.0	4.8	4.4	4.0	4.6	7.5	2.7
Capital	6.7	4.6	8.4	7.8	8.8	7.0	1.5	11.3	15.1	8.8
Labour	5.8	3.3	7.5	10.2	5.7	3.8	2.7	4.7	6.9	3.3
Energy	5.6	0.9	9.3	16.8	4.3	6.7	3.8	9.0	16.5	4.0
Materials	5.8	4.6	6.3	10.4	4.0	4.2	4.6	3.9	7.2	1.7
Services	5.7	3.0	7.9	9.7	6.8	6.4	2.9	9.2	10.3	8.5

Source: Estimates by the authors, based on data from Statistics Canada and the U.S. Department of Labor.

Table A-6

Average annual growth in output, inputs, and TFP in the paper and allied products industry, Canada-U.S. comparisons, 1962-88

	Canada					United States				
	1962-88	1962-73	1974-88	1974-79	1980-88	1962-88	1962-73	1974-88	1974-79	1980-88
	(Average annual per cent change)									
Gross output	3.5	4.9	2.3	2.5	2.2	3.3	4.8	2.2	2.0	2.3
Inputs	3.3	4.3	2.4	2.2	2.6	2.4	3.5	1.8	2.3	1.2
Capital	4.5	5.5	3.7	-0.2	6.3	3.8	4.0	3.3	4.4	2.6
Labour	0.9	2.0	0.1	0.7	-0.4	0.5	1.3	-0.2	-0.2	-0.1
Energy	3.8	5.8	2.4	4.8	0.7	2.4	4.7	0.5	1.9	-0.4
Materials	4.1	5.4	3.0	3.0	3.0	3.1	4.2	2.1	2.9	1.6
Services	4.7	5.6	4.1	3.3	4.8	5.2	7.4	3.4	4.6	2.6
TFP	0.2	0.6	-0.1	0.3	-0.4	0.9	1.3	0.6	-0.3	1.1

Source Estimates by the authors, based on data from Statistics Canada and the U.S. Department of Labor.

Table A-7

Average annual growth in input productivities and TFP in the paper and allied products industry, Canada-U.S. comparisons, 1962-88

	Canada					United States				
	1962-88	1962-73	1974-88	1974-79	1980-88	1962-88	1962-73	1974-88	1974-79	1980-88
	(Average annual per cent change)									
TFP	0.2	0.6	-0.1	0.3	-0.4	0.9	1.3	0.6	-0.3	1.1
Input productivities										
Capital	-0.7	-0.4	-0.9	2.7	-3.4	-0.3	0.8	-1.1	-2.3	-0.3
Labour	2.5	2.9	2.2	1.7	2.6	2.6	3.4	2.3	2.2	2.4
Energy	-0.3	-0.7	0.0	-2.3	1.5	1.0	0.2	1.7	0.1	2.7
Materials	-0.7	-0.5	-0.7	-0.6	-0.8	0.3	0.5	0.1	-1.0	0.8
Services	-1.3	-0.7	-1.8	-1.0	-2.2	-1.6	-2.4	-1.0	-2.1	-0.2

Source Estimates by the authors, based on data from Statistics Canada and the U.S. Department of Labor.

Table A-8

Average annual growth in output price, input prices, and TFP in the paper and allied products industry, Canada-U.S. comparisons, 1962-88

	Canada					United States				
	1962-88	1962-73	1974-88	1974-79	1980-88	1962-88	1962-73	1974-88	1974-79	1980-88
	(Average annual per cent change)									
Gross output price	6.4	2.6	9.5	13.7	6.7	5.0	2.1	7.3	10.5	5.1
Input prices	6.6	3.2	9.4	14.0	6.3	5.9	3.4	7.9	10.2	6.2
Capital[1]	10.3	1.7	17.1	27.5	10.2	6.0	3.1	8.3	5.4	10.2
Labour	6.1	6.3	9.6	12.2	7.8	7.0	5.4	8.1	10.6	6.4
Energy	7.1	1.5	11.5	18.7	6.7	7.7	3.6	11.0	21.7	3.8
Materials	5.6	2.5	8.2	12.0	5.6	5.1	2.3	7.3	10.2	5.4
Services	5.2	2.8	7.2	9.8	5.4	5.3	3.5	6.7	7.5	6.1
TFP	0.2	0.8	-0.1	0.3	-0.4	0.9	1.3	0.6	-0.3	1.1

1 Variations in the price of capital include variations in profit margins.

Source Estimates by the authors, based on data from Statistics Canada and the U.S. Department of Labor.

Table A-9

Average annual growth in output price and input costs in the paper and allied products industry, Canada-U.S. comparisons, 1962-88

	Canada					United States				
	1962-88	1962-73	1974-88	1974-79	1980-88	1962-88	1962-73	1974-88	1974-79	1980-88
	(Average annual per cent change)									
Gross output price	6.4	2.6	9.5	13.7	6.7	5.0	2.1	7.3	10.5	5.1
Input costs	6.4	2.6	9.5	13.7	6.7	5.0	2.1	7.3	10.5	5.1
Capital	9.9	1.4	16.7	22.6	12.8	6.1	2.0	9.4	7.8	10.4
Labour	5.7	3.4	7.6	11.1	5.3	4.1	2.1	5.7	8.3	3.9
Energy	7.6	2.3	11.8	21.7	5.2	6.9	3.4	9.6	22.5	1.1
Materials	6.4	3.0	9.1	12.9	6.5	4.9	1.8	7.4	11.5	4.7
Services	6.7	3.5	9.3	11.4	8.0	7.3	6.2	8.1	10.4	6.8

Source Estimates by the authors, based on data from Statistics Canada and the U.S. Department of Labor.

Canada-U.S. Comparisons

TFP growth averaged 0.9 per cent per year in the U.S. paper and allied products industry compared to only 0.2 per cent in Canada over the 1962-88 period (see Table A-6). This result is consistent with the findings of Rao and Lemprière [1992*a*] which shows a steady increase in the U.S.-Canada labour productivity gap in this industry.

As in the food and beverage industry, the response of the input mix to the two energy price shocks was much slower and weaker in the Canadian industry than in the U.S. industry. For example, its energy/output ratio increased at an annual rate of 2.3 per cent during the 1974-79 period, compared to only a 0.7-per-cent growth in the 1962-73 period. In sharp contrast, the U.S. industry's energy/output ratio declined at an annual rate of 0.1 per cent during the 1974-79 period (see Tables A-6 and A-7).

As was the case in the food and beverage industry, the cost/price performance of the paper and allied products industry in Canada was significantly worse than that of the U.S. industry during the 1974-88 period (see Table A-8 and A-9). The growth rate of the output price averaged 9.5 per cent in Canada, compared to only 7.3 per cent in the United States. However, this deterioration in relative price performance was offset by the large drop (about 30 per cent) in the value of the Canadian dollar during most of the period. The appreciation of the Canadian dollar relative to the U.S. currency since then suggests that the industry has experienced a substantial deterioration in its cost competitiveness.

Primary Metals Industry

As in the other Canadian manufacturing industries, the output expansion of this industry slowed markedly during the post-1973 period. Its output growth rate declined from 5.4 per cent per year during the 1962-73 period to a mere 1.9 per cent in the post-1973 period (see Table A-10). The slowdown in its TFP growth rate from 1.0 to 0.4 per cent directly accounted for only about 20 per cent of the output slowdown although indirect effects may be large. However, the fall in TFP growth was directly responsible for close to 80 per cent of the reduction in labour productivity growth during the post-1973 period (see Table A-11).

The acceleration in the industry's cost/price inflation during the 1974-88 period was dramatic. For instance, the growth rate of its output price increased from 3.2 per cent per year in the 1962-73 period to 8.8 per cent during the post-73 period. Accelerated input price growth accounted for close to 90 per cent of this increase (see Tables A-12 and A-13).

Table A-10

Average annual growth in output, inputs, and TFP in the primary metal products industry, Canada-U.S. comparisons, 1962-88

	Canada					United States				
	1962-88	1962-73	1974-88	1974-79	1980-88	1962-88	1962-73	1974-88	1974-79	1980-88
	(Average annual per cent change)									
Gross output	3.4	5.4	1.9	0.4	2.8	1.2	4.5	-1.4	-0.7	-1.9
Inputs	2.7	4.3	1.5	1.1	1.6	1.2	4.0	-1.0	1.0	-2.4
Capital	2.9	3.8	2.2	2.0	2.2	1.9	3.2	0.8	2.0	0.0
Labour	0.8	2.3	-0.4	1.5	-1.6	-0.8	1.6	-2.6	-0.4	-4.1
Energy	2.9	5.8	0.6	1.2	0.2	1.3	4.7	-1.4	1.1	-3.0
Materials	3.3	5.1	1.9	0.2	3.1	1.9	5.3	-0.8	1.1	-2.0
Services	4.6	6.2	3.3	4.5	2.5	4.1	5.2	3.3	5.3	1.9
TFP	0.7	1.1	0.4	-0.7	1.2	0.0	0.5	-0.4	-1.7	0.5

Source Estimates by the authors, based on data from Statistics Canada and the U.S. Department of Labor.

Table A-11

Average annual growth in input productivities and TFP in the primary metal products industry, Canada-U.S. comparisons, 1962-88

	Canada					United States				
	1962-88	1962-73	1974-88	1974-79	1980-88	1962-88	1962-73	1974-88	1974-79	1980-88
	(Average annual per cent change)									
TFP	0.7	1.1	0.4	-0.7	1.2	0.0	0.5	-0.4	-1.7	0.5
Input productivities										
Capital	0.7	1.6	-0.0	-1.4	0.9	-0.6	1.4	-2.1	-2.7	-1.7
Labour	2.6	3.1	2.2	-1.1	4.4	1.8	2.8	1.0	-0.5	2.1
Energy	0.6	-0.2	1.3	-0.8	2.7	-0.1	-0.2	0.1	-2.0	1.4
Materials	0.2	0.3	0.0	0.4	-0.2	-0.6	-0.7	-0.6	-1.9	0.2
Services	-1.1	-0.7	-1.4	-3.9	0.2	-2.2	-0.5	-3.6	-5.3	-2.5

Source Estimates by the authors, based on data from Statistics Canada and the U.S. Department of Labor.

Table A-12

Average annual growth in output price, input prices, and TFP in the primary metal products industry, Canada-U.S. comparisons, 1962-88

	Canada					United States				
	1962-88	1962-73	1974-88	1974-79	1980-88	1962-88	1962-73	1974-88	1974-79	1980-88
	(Average annual per cent change)									
Gross output price	8.3	3.2	8.8	14.2	5.2	5.6	3.0	7.6	13.0	4.0
Input prices	7.0	4.3	9.2	13.5	6.4	5.8	3.5	7.2	11.3	4.5
Capital[1]	16.6	4.0	26.7	15.0	34.5	13.2	4.0	20.7	12.5	26.1
Labour	8.2	6.3	9.7	11.2	8.6	6.3	5.5	6.9	10.9	4.3
Energy	7.4	2.3	11.5	22.4	4.3	7.5	2.7	11.3	19.7	5.7
Materials	6.8	3.7	9.0	14.5	5.2	5.1	2.8	7.1	11.1	4.4
Services	5.0	3.8	6.1	9.2	4.0	5.4	3.8	6.8	7.7	6.1
TFP	0.7	1.1	0.4	–0.7	1.2	0.0	0.5	–0.4	–1.7	0.5

1 Variations in the price of capital include variations in profit margins.
Source Estimates by the authors, based on data from Statistics Canada and the U.S. Department of Labor.

Table A-13

Average annual growth in output price and input costs in the primary metal products industry, Canada-U.S. comparisons, 1962-88

	Canada					United States				
	1962-88	1962-73	1974-88	1974-79	1980-88	1962-88	1962-73	1974-88	1974-79	1980-88
	(Average annual per cent change)									
Gross output price	6.3	3.2	8.8	14.2	5.2	5.8	3.0	7.8	13.0	4.0
Input costs	6.3	3.2	8.8	14.2	5.2	5.8	3.0	7.8	13.0	4.0
Capital	13.5	2.1	22.6	15.9	27.1	12.4	2.3	20.5	14.4	24.5
Labour	5.8	3.2	7.9	12.7	4.7	4.8	2.8	6.1	11.7	2.4
Energy	6.9	2.8	10.3	23.2	1.8	7.8	3.0	11.8	22.3	4.5
Materials	6.5	3.4	9.0	14.3	5.8	5.7	3.3	7.7	13.2	4.1
Services	6.2	4.3	7.8	13.6	3.9	8.5	4.5	11.7	14.4	9.9

Source: Estimates by the authors, based on data from Statistics Canada and the U.S. Department of Labor.

Canada-U.S. Comparisons

The post-1973 slowdown in output and TFP in the industry was more pronounced in the United States than in Canada. TFP declined at an average annual rate of 0.4 per cent in the U.S. industry during the 1974-88 period, compared to 0.4 per cent growth in Canada (see Table A-10). Canada also experienced superior labour productivity growth after 1973 due largely to a smaller slowdown (on average) in the substitution of other inputs for labour.

The adjustments in input mix to the two energy price shocks were much stronger in the Canadian primary metals industry than in the U.S. industry. In Canada, the industry's energy/output ratio declined by 1.3 per cent per year during the post-1973 period, compared to only 0.1 per cent in the United States (see Table A-11). The beter adjustment in Canada was likely one reason for its better productivity performance.

The stronger TFP performance of the Canadian industry was more than offset by the adverse effect of faster growth of its input prices. Thus output price inflation was greater in Canada in 1974-88, although the depreciation of the Canadian dollar counterbalanced this difference (see Table A-12). The large appreciation of the Canadian dollar since 1986 implies that the Canadian industry lost significant ground to its U.S. competitor during the 1986-91 period, similar to the findings of Rao and Lemprière [1992*a*] on trends in unit labour costs.

Wood Products Industry

In sharp contrast to the slowdown of TFP in most other Canadian manufacturing industries, the growth rate of the Canadian wood industry's TFP increased between the 1962-73 and 1974-88 periods (see Table A-14). But input growth slowed considerably so that output growth fell. These divergent trends in TFP and output imply that the output slowdown could have been largely caused by a slowdown in world demand for wood products.

Labour productivity growth remained steady at just above 3 per cent per year in both periods. A strong response of the input mix to changes in relative input prices seems to have contributed to the good productivity performance of the industry during the post-1973 period. For instance, productivity growth rates of the intermediate inputs (energy, materials, and services) improved substantially between the two periods (see Table A-15).

Strong TFP performance and the changes in input mix helped the industry to improve its cost/price performance during the post-1973 period (see Tables A-16 and A-17). Output price growth declined in the second period compared to the first (from 6.2 to 5.4 per cent).

Table A-14

Average annual growth in output, inputs, and TFP in the wood industry, Canada-U.S. comparisons, 1962-88

	Canada					United States				
	1962-88	1962-73	1974-88	1974-79	1980-88	1962-88	1962-73	1974-88	1974-79	1980-88
	(Average annual per cent change)									
Gross output	4.9	5.8	4.2	3.7	4.6	3.5	5.1	2.2	1.2	2.9
Inputs	3.7	5.0	2.8	2.8	2.8	2.1	2.9	1.4	0.8	1.8
Capital	4.5	8.3	1.5	2.5	1.0	2.2	3.5	1.2	3.8	-0.6
Labour	1.6	2.6	0.8	1.6	0.4	0.9	1.5	0.5	0.6	0.4
Energy	4.3	6.7	2.3	4.1	1.2	4.6	10.5	-0.2	-2.6	1.4
Materials	4.8	5.9	3.9	3.3	4.2	2.6	3.3	2.1	0.9	2.9
Services	5.7	7.2	4.6	4.1	4.9	5.2	7.5	3.3	7.3	0.7
TFP	1.2	0.8	1.4	0.9	1.8	1.4	2.2	0.8	0.4	1.1

Source Estimates by the authors, based on data from Statistics Canada and the U.S. Department of Labor.

Table A-15

Average annual growth in input productivities and TFP in the wood industry, Canada-U.S. comparisons, 1962-88

	Canada					United States				
	1962-88	1962-73	1974-88	1974-79	1980-88	1962-88	1962-73	1974-88	1974-79	1980-88
	(Average annual per cent change)									
TFP	1.2	0.8	1.4	0.9	1.8	1.4	2.2	0.8	0.4	1.1
Input productivities										
Capital	1.0	−1.9	3.2	1.5	4.4	1.4	1.8	1.3	−2.4	3.7
Labour	3.2	3.3	3.2	2.0	4.0	2.7	3.6	2.0	1.0	2.6
Energy	0.7	−0.8	1.7	−0.5	3.2	0.8	−2.0	2.7	4.2	1.8
Materials	0.2	0.0	0.4	0.5	0.4	1.0	1.9	0.3	0.8	0.0
Services	−0.8	−1.2	−0.4	−0.5	−0.4	−1.1	−1.7	−0.6	−5.5	2.7

Source: Estimates by the authors, based on data from Statistics Canada and the U.S. Department of Labor.

Table A-16

Average annual growth in output price, input prices, and TFP in the wood industry, Canada-U.S. comparisons, 1962-88

	Canada					United States				
	1962-88	1962-73	1974-88	1974-79	1980-88	1962-88	1962-73	1974-88	1974-79	1980-88
	(Average annual per cent change)									
Gross output price	5.8	6.2	5.4	10.1	2.3	5.0	5.4	4.7	9.2	1.8
Input prices	7.0	7.0	6.8	11.0	4.1	6.4	7.6	5.5	9.6	2.7
Capital[1]	-13.1	19.3	-39.1	16.7	76.4	10.5	12.0	9.3	7.8	10.3
Labour	8.4	7.5	9.0	13.1	6.3	6.7	7.0	6.4	9.1	4.6
Energy	6.6	1.9	10.3	15.6	6.8	5.8	0.2	10.3	18.0	5.2
Materials	5.9	5.7	6.1	10.9	2.9	6.2	7.8	4.8	10.2	1.3
Services	5.6	3.9	6.9	10.4	4.6	5.4	3.7	6.9	7.8	6.2
TFP	1.2	0.8	1.4	0.9	1.8	1.4	2.2	0.8	0.4	1.1

1 Variations in the price of capital include variations in profit margins.
Source Estimates by the authors, based on data from Statistics Canada and the U.S. Department of Labor.

Table A-17

Average annual growth in output price and input costs in the wood industry, Canada-U.S. comparisons, 1962-88

	Canada					United States				
	1962-88	1962-73	1974-88	1974-79	1980-88	1962-88	1962-73	1974-88	1974-79	1980-88
	(Average annual per cent change)									
Gross output price	5.8	6.2	5.4	10.1	2.3	5.0	5.4	4.7	9.2	1.8
Input costs	5.8	6.2	5.4	10.1	2.3	5.0	5.4	4.7	9.2	1.8
Capital	-10.5	20.6	-35.3	12.2	-66.9	8.1	10.0	6.5	9.6	4.5
Labour	5.1	4.2	5.8	11.0	2.3	4.1	3.5	4.5	8.3	2.0
Energy	6.1	2.7	8.9	16.2	3.8	6.2	4.6	7.4	13.4	3.4
Materials	5.8	5.8	5.8	10.5	2.6	5.1	5.8	4.6	9.5	1.3
Services	6.6	5.3	7.6	11.1	5.2	7.1	6.0	8.0	14.3	3.8

Source Estimates by the authors, based on data from Statistics Canada and the U.S. Department of Labor.

Canada-U.S. Comparisons

Unlike its Canadian counterpart, TFP growth slowed dramatically in the U.S. wood industry during the post-1973 period, falling to 0.8 per cent per year during 1974-88 from 2.2 per cent in the 1962-73 period (see Table A-14). This decline in TFP growth was responsible for much of the decline in output growth, and was itself largely caused by the slowdown in the productivity of capital, labour, and material inputs (see Table A-15).

As in most other manufacturing industries, the U.S. wood industry seems to have responded much more quickly and strongly to the energy price shock. The Canadian energy/output ratio rose by 0.5 per cent per year in the 1974-79 period, compared to a negative growth rate of 4.2 per cent in the U.S. industry.

Transportation Equipment Industry

The output growth rate of this industry averaged an impressive 13.1 per cent per year during the 1962-73 period, largely due to the substantial beneficial effects of the Auto Pact on TFP and exports to the United States. The growth in TFP directly accounted for over 20 per cent of output growth in this period. The dramatic increases in intermediate input growth suggest that the total (direct as well as indirect) contribution of TFP growth to output growth was substantial (see Table A-18).

During the 1974-88 period TFP and output growth rates declined dramatically. The slowdown in TFP growth directly accounted for about 30 per cent of the slowdown in output growth compared to the earlier period, although the total contribution was likely much larger because of the indirect effect on the growth of inputs. Similarly, the drop in labour productivity growth between the two periods was largely due to the drop in TFP growth (see Tables A-18 and A-19).

An acceleration in input price inflation and the TFP slowdown combined to substantially increase output prices during the 1974-88 period (see Table A-20). The growth rate of the industry's output price increased from a mere 1.8 per cent in the first period to 7.7 per cent per year during the 1974-88 period. About 45 per cent of this increase was directly caused by the slowdown in TFP growth.

Canada-U.S. Comparisons

TFP growth in the United States was 1.4 per cent per year in the 1962-73 period, half the Canadian level. But, although both TFP and output growth

Table A-18

Average annual growth in output, inputs, and TFP in the transportation equipment industry, Canada-U.S. comparisons, 1962-88

	Canada					United States				
	1962-88	1962-73	1974-88	1974-79	1980-88	1962-88	1962-73	1974-88	1974-79	1980-88
	(Average annual per cent change)									
Gross output	8.2	13.1	4.3	2.9	5.3	3.9	5.9	2.3	2.1	2.4
Inputs	6.9	10.3	4.2	2.5	5.4	3.0	4.5	1.9	2.0	1.8
Capital	7.3	5.6	8.7	3.3	12.3	4.0	5.1	3.1	2.3	3.6
Labour	3.3	5.4	1.7	1.5	1.9	1.2	1.9	0.7	0.9	0.6
Energy	5.3	9.1	2.2	-0.2	3.7	3.2	6.8	0.5	-0.5	1.2
Materials	8.3	13.0	4.8	2.3	6.1	3.8	5.7	2.2	1.9	2.4
Services	7.4	11.4	4.2	6.0	2.9	5.7	7.8	4.1	10.3	-0.1
TFP	1.3	2.8	0.1	0.4	-0.1	0.9	1.4	0.4	0.1	0.8

Source: Estimates by the authors, based on data from Statistics Canada and the U.S. Department of Labor.

Table A-19

Average annual growth in input productivities and TFP in the transportation equipment industry, Canada-U.S. comparisons, 1962-88

	Canada					United States				
	1962-88	1962-73	1974-88	1974-79	1980-88	1962-88	1962-73	1974-88	1974-79	1980-88
	(Average annual per cent change)									
TFP	1.3	2.8	0.1	0.4	-0.1	0.9	1.4	0.4	0.1	0.6
Input productivities										
Capital	2.3	8.2	-2.3	0.1	-3.9	0.1	1.0	-0.8	-0.1	-1.0
Labour	4.6	7.3	2.5	1.4	3.1	2.5	3.9	1.4	1.0	1.7
Energy	2.9	3.9	2.0	3.1	1.3	0.8	-0.3	1.8	2.5	1.0
Materials	0.0	0.2	-0.1	0.6	-0.7	0.2	0.2	0.2	0.3	0.1
Services	0.8	1.5	0.2	-2.8	2.5	-0.9	-1.0	-0.9	-6.5	2.9

Source Estimates by the authors, based on data from Statistics Canada and the U.S. Department of Labor.

Table A-20

Average annual growth in output price, input prices, and TFP in the transportation equipment industry, Canada-U.S. comparisons, 1962-88

	Canada					United States				
	1962-88	1962-73	1974-88	1974-79	1980-88	1962-88	1962-73	1974-88	1974-79	1980-88
	(Average annual per cent change)									
Gross output price	5.1	1.8	7.7	10.3	6.1	4.5	2.2	6.3	5.8	4.6
Input prices	6.4	4.8	7.8	10.7	6.0	5.4	3.6	6.7	8.9	5.2
Capital[1]	11.9	16.4	8.2	4.3	10.8	27.2	5.0	45.0	7.8	70.0
Labour	7.8	6.4	8.9	10.8	7.6	6.8	6.1	7.3	9.6	5.7
Energy	6.8	1.5	11.0	17.6	6.5	7.1	2.1	11.0	19.3	5.5
Materials	5.7	2.6	8.2	11.8	5.9	4.8	2.6	6.7	9.9	4.5
Services	6.2	3.7	8.2	9.5	7.2	5.2	3.2	6.8	7.7	6.3
TFP	1.3	2.8	0.1	0.4	–0.1	0.9	1.4	0.4	0.1	0.6

1 Variations in the price of capital include variations in profit margins.
Source Estimates by the authors, based on data from Statistics Canada and the U.S. Department of Labor.

slowed significantly in the United States, the slowdown was less severe than in Canada. Between the two periods, output growth rate dropped by 3.6 percentage points in the United States, compared to an 8.8-percentage-point fall in Canada (see Table A-18). In addition, TFP growth accelerated in the United States during the 1980-88 period, averaging 0.6 per cent per year, while in Canada the industry experienced negative growth of 0.1 per cent.

As in Canada, the cost/price performance of the U.S. transportation equipment industry substantially deteriorated during the post-1973 period (see Tables A-20 and A-21). But, the growth rate of its output price averaged 1.4-percentage-point per year lower than in Canada. This was primarily due to the smaller drop in TFP in the United States between the two periods. In the 1974-86 period, higher price growth was more than offset by the fall in the value of the Canadian dollar (by 30 per cent).

The more recent trends (1980-88 period) in the cost/price performance of the industry in the two countries, and the large appreciation of the Canadian dollar since 1986, strongly imply a substantial deterioration (about 35 per cent) in the competitive position of the Canadian industry over the 1986-91 period. In turn, this suggests that the short- to medium-term outlook for the exports, output, employment, prices, and trade balance of the industry will be poor. To improve this outlook, the industry needs to achieve significantly better relative productivity and cost performance over the next few years, and/or benefit from a large real depreciation of the Canadian dollar.

Chemicals and Chemical Products Industry

The output growth of the chemical industry declined from an annual rate of 6.6 per cent during the 1962-73 period to 4.0 per cent in the 1974-88 period. The slowdown in TFP growth was directly responsible for nearly 70 per cent of the slowdown in output growth between the two periods (see Table A-22).

The industry's labour productivity growth rate dropped from 4.8 per cent in the first period to 2.7 per cent in the second period, somewhat less than the fall in TFP of 1.8 percentage point, suggesting a small increase in the contribution of nonlabour inputs to the improvements in labour productivity. The increase in the growth rate of the capital/labour ratio from 1.1 per cent in the first period (1962-73) to 3.4 per cent in the post-1973 period accounted for much of this contribution (see Tables A-22 and A-23).

As in almost every Canadian manufacturing industry, adjustments in input mix to changes in relative input prices were much slower and weaker in this industry than in its U.S. counterpart. For instance, its energy/output ratio (the inverse of energy productivity) increased by a staggering 4.2 per cent per

Table A-21

Average annual growth in output price and input costs in the transportation equipment industry, Canada-U.S. comparisons, 1962-88

	Canada					United States				
	1962-88	1962-73	1974-88	1974-79	1980-88	1962-88	1962-73	1974-88	1974-79	1980-88
	(Average annual per cent change)									
Gross output price	5.1	1.8	7.7	10.3	6.1	4.5	2.2	6.3	8.8	4.6
Input costs	5.1	1.8	7.7	10.3	6.1	4.5	2.2	6.3	8.8	4.6
Capital	7.3	6.1	8.3	4.2	11.1	27.1	2.5	48.7	5.9	74.0
Labour	3.5	−0.5	6.7	9.3	5.0	4.4	2.3	6.1	8.7	4.4
Energy	4.4	−1.8	9.1	14.0	5.8	6.8	3.1	9.7	16.8	5.0
Materials	5.7	2.5	8.4	11.1	6.5	4.7	2.4	6.5	9.5	4.5
Services	5.8	2.4	8.5	12.9	5.8	7.4	5.2	9.1	17.1	3.8

Source Estimates by the authors, based on data from Statistics Canada and the U.S. Department of Labor.

Table A-22

Average annual growth in output, inputs, and TFP in the chemical and chemical products industry, Canada-U.S. comparisons, 1962-88

	Canada					United States				
	1962-88	1962-73	1974-88	1974-79	1980-88	1962-88	1962-73	1974-88	1974-79	1980-88
	(Average annual per cent change)									
Gross output	5.1	6.6	4.0	5.5	2.9	4.2	6.7	2.2	3.2	1.6
Inputs	3.9	4.4	3.6	6.4	1.7	3.1	4.9	1.7	3.6	0.5
Capital	3.8	2.9	4.6	12.9	–0.9	3.9	5.2	2.8	5.4	1.1
Labour	1.5	1.8	1.2	1.7	0.9	0.9	1.8	0.2	1.0	–0.3
Energy	5.2	6.9	3.8	10.9	–0.9	1.2	3.1	–0.3	1.8	–1.7
Materials	5.4	6.6	4.4	5.2	3.9	4.0	6.4	2.0	3.9	0.8
Services	5.0	5.5	4.5	5.7	3.7	5.8	8.2	3.9	7.2	1.6
TFP	1.2	2.2	0.4	–0.9	1.2	1.1	1.8	0.5	–0.4	1.1

Source Estimates by the authors, based on data from Statistics Canada and the U.S. Department of Labor.

Table A-23

Average annual growth in input productivities and TFP in the chemical and chemical products industry, Canada-U.S. comparisons, 1962-88

	Canada					United States				
	1962-88	1962-73	1974-88	1974-79	1980-88	1962-88	1962-73	1974-88	1974-79	1980-88
	(Average annual per cent change)									
TFP	1.2	2.2	0.4	–0.9	1.2	1.1	1.8	0.5	–0.4	1.1
Input productivities										
Capital	2.1	4.1	0.6	–5.9	4.9	0.4	1.5	–0.5	–2.1	0.5
Labour	3.6	4.8	2.7	3.7	2.0	3.3	4.9	1.9	2.0	1.9
Energy	0.4	–0.1	0.7	–4.2	4.0	3.1	3.6	2.7	1.4	3.6
Materials	–0.2	0.1	–0.4	0.3	–0.9	0.3	0.3	0.3	–0.6	0.9
Services	0.2	1.1	–0.6	–0.2	–0.8	–1.3	–1.2	–1.4	–3.7	0.1

Source: Estimates by the authors, based on data from Statistics Canada and the U.S. Department of Labor.

year during the 1974-79 period, compared to a negative growth rate of 1.4 per cent in the U.S. industry (see Table A-23).

The cost/price performance of the chemical industry deteriorated quite substantially during the 1974-88 period – its output price inflation increased from a mere 1.2 per cent per year during the 1962-73 period to 9.2 per cent in the 1974-88 period (see Tables A-24 and A-25). An acceleration in input price inflation accounted for close to 80 per cent of this increase.

Canada-U.S. Comparisons

The post-1973 slowdown in output growth was much more dramatic in the U.S. industry than in Canada. But, unlike the experience in Canada, the TFP slowdown directly accounted for only about 30 per cent of the slowdown in output growth in the United States, although both countries experienced sharp TFP growth slowdowns (see Table A-22). A reduction in the demand for U.S. chemical products at home and abroad, perhaps precipitated by the high U.S. dollar in this period, likely played an important role in the U.S. output growth slowdown.

The cost/price performance of the U.S. industry was better than its Canadian counterpart during the 1974-88 period. Its output price inflation averaged 7.6 per cent per year, compared to 9.2 per cent in the Canadian industry (see Table A-24). However, the large depreciation of the Canadian dollar during most of this period more that offset the better performance in the United States. Since then, the large appreciation of the Canadian dollar, and the recent trends (1980-88) in the cost/price performance of the industry in the two countries, imply that a substantial erosion (about 30 per cent) of the competitive position of the Canadian industry vis-à-vis its U.S. counterpart has occurred.

Electrical Machinery Industry

The industry's TFP growth averaged 2.7 per cent per year during the 1962-73 period, and remained strong in the following decade and a half, although it declined to 2.3 per cent per year. Output growth declined from 7.7 per cent in the first period to 7.0 per cent during the 1974-88 period, indicating that TFP was largely responsible for the slowdown in output (see Table A-26).

In sharp contrast to the experience of most Canadian manufacturing industries, the industry's labour productivity growth increased considerably between the two periods (see Table A-27). This indicates that increases in the ratio of nonlabour inputs to labour made a large contribution to labour productivity growth, since TFP growth declined. The changes in the input mix

Table A-24

Average annual growth in output price, input prices, and TFP in the chemical and chemical products industry, Canada-U.S. comparisons, 1962-88

	Canada					United States				
	1962-88	1962-73	1974-88	1974-79	1980-88	1962-88	1962-73	1974-88	1974-79	1980-88
	(Average annual per cent change)									
Gross output price	5.7	1.2	9.2	13.3	6.5	4.5	0.6	7.6	11.9	4.8
Input prices	6.9	3.4	9.6	12.4	7.7	5.6	2.4	8.1	11.5	5.9
Capital[1]	9.8	4.5	14.0	9.2	17.2	4.9	1.3	7.9	3.1	11.1
Labour	7.8	6.1	9.1	11.1	7.8	6.7	5.3	7.8	10.2	6.1
Energy	8.1	1.6	13.3	23.6	6.5	7.8	4.2	10.7	22.0	3.4
Materials	5.5	1.4	8.8	14.1	5.4	5.0	0.9	8.4	14.1	4.6
Services	5.4	3.0	7.4	9.4	6.0	5.2	3.3	6.7	7.4	6.2
TFP	1.2	2.2	0.4	-0.9	1.2	1.1	1.8	0.5	-0.4	1.1

1 Variations in the price of capital include variations in profit margins.

Source Estimates by the authors, based on data from Statistics Canada and the U.S. Department of Labor.

Table A-25

Average annual growth in output price and input costs in the chemical and chemical products industry, Canada-U.S. comparisons, 1962-88

	Canada					United States				
	1962-88	1962-73	1974-88	1974-79	1980-88	1962-88	1962-73	1974-88	1974-79	1980-88
	(Average annual per cent change)									
Gross output price	5.7	1.2	9.2	13.3	6.5	4.5	0.6	7.6	11.9	4.8
Input costs	5.7	1.2	9.2	13.3	6.5	4.5	0.6	7.6	11.9	4.8
Capital	7.1	0.2	12.6	15.0	11.0	4.6	-0.3	8.5	5.8	10.3
Labour	4.2	1.3	6.5	7.4	5.9	3.5	0.4	6.0	8.4	4.5
Energy	8.2	1.8	13.3	29.2	2.6	4.9	0.6	8.4	21.4	-0.3
Materials	5.8	1.4	9.4	13.9	6.4	4.8	0.6	8.2	14.9	3.7
Services	5.4	2.0	8.1	9.8	6.9	6.9	4.7	8.6	12.0	6.3

Source: Estimates by the authors, based on data from Statistics Canada and the U.S. Department of Labor.

Table A-26

Average annual growth in output, inputs, and TFP in the electrical products industry,[1] Canada-U.S. comparisons, 1962-88

	Canada					United States				
	1962-88	1962-73	1974-88	1974-79	1980-88	1962-88	1962-73	1974-88	1974-79	1980-88
	(Average annual per cent change)									
Gross output	7.3	7.7	7.0	3.7	9.2	5.8	7.3	4.6	5.0	4.3
Inputs	4.8	5.0	4.7	1.3	6.9	3.7	4.7	2.8	3.2	2.5
Capital	5.0	4.6	5.3	–0.6	9.3	7.1	7.3	6.9	5.8	7.7
Labour	1.8	3.2	0.6	–0.8	1.5	1.5	2.8	0.5	1.1	0.1
Energy	3.9	6.7	1.7	0.1	2.8	3.6	7.8	0.3	–0.5	0.8
Materials	8.0	7.8	8.1	4.2	10.6	4.5	5.9	3.4	3.4	3.4
Services	5.1	6.0	4.4	2.3	5.8	8.0	8.9	7.2	11.2	4.6
TFP	2.5	2.7	2.3	2.4	2.3	2.1	2.6	1.8	1.8	1.8

1 The data for the United States and Canada are not strictly comparable. The Canadian industry includes computers while the U.S. industry does not.
Source Estimates by the authors, based on data from Statistics Canada and the U.S. Department of Labor.

Table A-27

Average annual growth in input productivities and TFP in the electrical products industry,[1] Canada-U.S. comparisons, 1962-88

	Canada					United States				
	1962-88	1962-73	1974-88	1974-79	1980-88	1962-88	1962-73	1974-88	1974-79	1980-88
	(Average annual per cent change)									
TFP	2.5	2.7	2.3	2.4	2.3	2.1	2.6	1.8	1.8	1.8
Input productivities										
Capital	2.4	3.2	1.7	4.3	0.0	–1.0	0.2	–2.0	–0.4	–3.1
Labour	5.4	4.3	6.3	4.5	7.5	4.2	4.4	4.0	3.7	4.2
Energy	3.7	1.0	5.8	3.8	7.1	2.3	–0.3	4.3	5.4	3.8
Materials	–0.5	–0.1	–0.8	–0.4	–1.1	1.3	1.4	1.2	1.6	0.9
Services	2.1	1.8	2.4	1.2	3.2	–0.9	–1.4	–0.5	–4.7	2.3

1 The data for the United States and Canada are not strictly comparable. The Canadian industry includes computers while the U.S. industry does not.

Source Estimates by the authors, based on data from Statistics Canada and the U.S. Department of Labor.

were, in turn, induced by large changes in relative input prices (see Tables A-26 and A-27).

The cost/price performance of the industry during the 1974-88 period was substantially better than average. During this period its output price grew at only 3.7 per cent per year, compared to the average growth rate of 7.7 per cent in the aggregate manufacturing sector (see Table 5 and A-28). Unlike most other Canadian manufacturing industries, the electrical products industry was able to make quick and large adjustments to its input basket in response to relative input price changes (especially energy). These results again suggest that the ease with which an industry adjusts to changes in relative input prices plays a crucial role in its relative productivity and cost performance.

Canadian-U.S. Comparisons

In comparing the data for the United States and Canada, it must be noted that the industry definitions have an important difference. The Canadian data include the computer industry while in the U.S. data it is assigned to the nonelectrical products industry. A priori, one might expect the inclusion of the rapidly growing computer industry in the Canadian data to introduce an upward bias to Canada's relative competitive performance vis-à-vis the United States.

Output growth in the United States slowed much more substantially than in Canada in the post-1973 period. Most of this larger decline was the result of a larger fall in input growth, although a greater fall in TFP growth was also partly to blame (see Table A-26).

The electrical products industry has continuously increased in importance in world trade over the last two decades, and competition has become fierce. Thus the competitive position of the industry is crucial for Canada's performance in high-technology trade. Like the wood industry, the Canadian industry substantially improved its relative cost position during the 1974-88 period, because of both slower growth in its output price and the large depreciation of the Canadian dollar between 1973 and 1986 (see Table A-28). However, the large appreciation of the Canadian dollar since 1986 has reduced the relative cost position of the Canadian industry.

Nonelectrical Machinery Industry

The industry performed poorly during the post-1973 period. Its average annual output growth rate declined from 9.3 per cent during the 1962-73 period

Table A-28

Average annual growth in output price, input prices, and TFP in the electrical products industry,[1] Canada-U.S. comparisons, 1962-88

	Canada					United States				
	1962-88	1962-73	1974-88	1974-79	1980-88	1962-88	1962-73	1974-88	1974-79	1980-88
	(Average annual per cent change)									
Gross output price	2.9	1.9	3.7	7.7	1.0	2.9	0.7	4.6	6.6	3.3
Input prices	5.4	4.6	6.0	10.1	3.3	5.0	3.3	6.4	8.4	5.1
Capital[2]	6.9	8.3	5.8	12.6	1.2	4.0	2.6	5.1	10.3	1.6
Labour	7.4	5.4	9.1	11.7	7.4	6.5	4.7	7.9	9.2	7.1
Energy	6.5	1.1	10.8	16.7	6.8	6.7	1.2	11.2	18.9	6.0
Materials	2.7	2.2	3.2	7.7	0.1	4.1	1.8	5.9	8.4	4.2
Services	5.2	3.1	6.9	8.8	5.6	5.2	3.2	6.8	7.5	6.3
TFP	2.5	2.7	2.3	2.4	2.3	2.1	2.6	1.8	1.8	1.8

1 The data for the United States and Canada are not strictly comparable. The Canadian industry includes computers while the U.S. industry does not.
2 Variations in the price of capital include variations in profit margins.
Source: Estimates by the authors, based on data from Statistics Canada and the U.S. Department of Labor.

Table A-29

Average annual growth in output price and input costs in the electrical products industry,[1] Canada-U.S. comparisons, 1962-88

	Canada					United States				
	1962-88	1962-73	1974-88	1974-79	1980-88	1962-88	1962-73	1974-88	1974-79	1980-88
	(Average annual per cent change)									
Gross output price	2.9	1.9	3.7	7.7	1.0	2.9	0.7	4.6	6.6	3.3
Input costs	2.9	1.9	3.7	7.7	1.0	2.9	0.7	4.6	6.6	3.3
Capital	4.0	4.0	3.9	7.9	1.2	5.0	2.1	7.3	11.5	4.6
Labour	2.2	1.1	3.0	7.1	0.3	2.3	0.3	3.9	5.5	2.8
Energy	3.6	0.3	6.2	14.1	0.9	4.6	1.6	7.1	13.5	2.8
Materials	3.3	2.3	4.1	8.2	1.3	2.8	0.4	4.7	6.8	3.3
Services	3.2	1.5	4.5	7.6	2.5	7.4	4.9	9.4	14.0	6.3

1 The data for the United States and Canada are not strictly comparable. The Canadian industry includes computers while the U.S. industry does not.
Source Estimates by the authors, based on data from Statistics Canada and the U.S. Department of Labor.

to 2.6 per cent in the 1974-88 period. A slowdown in TFP growth directly accounted for over 25 per cent of this decline (see Table A-30). However, since much of the slowdown in input growth was due to the reduction in the growth rate of material and service inputs whose demand growth directly depends on output growth, the total effect of the TFP slowdown on output growth was likely much more substantial.

Labour productivity growth declined from 4.3 per cent per year in the first period (1962-73) to only 0.6 per cent in the 1974-88 period. Nearly 50 per cent of the drop resulted from the TFP growth slowdown, and a slowdown in the rate of substitution of materials and service inputs for labour accounted for much of the remainder (see Table A-30).

Canada-U.S. Comparisons

In comparing the Canadian and U.S. industries, it must be kept in mind that the industry definitions have an important difference, as explained above.

In sharp contrast to the poor Canadian performance, the TFP growth rate of the U.S. industry increased from 1.7 per cent per year in the 1962-73 period to 2.4 per cent during the 1974-88 period (see Table A-30). However, its output growth declined from 7.5 per cent per year in the first period to 6.0 per cent in the second period, suggesting that a slowdown in demand for the U.S. products at home and abroad (due to the large appreciation of the U.S. dollar) played an important role in the output slowdown.

As was the case with most Canadian manufacturing industries, the adjustments in this industry's input mix in reaction to the two energy price shocks were slower and weaker than in the United States. Its energy output ratio declined by an average of only 1.2 per cent per year during the 1974-79 period, compared to an average decline of 5.8 per cent in the United States (see Table A-31).

Output price (unit costs) grew at an average rate of 8.3 per cent in the Canadian industry during the 1974-88 period, compared to only 2.4 per cent in the U.S. industry. The difference in TFP growth rates directly accounted for over 70 per cent of the difference (see Tables A-32 and A-33).

The vast difference in price growth implies that the cost competitive position of the Canadian industry deteriorated markedly (roughly 60 per cent) during the 1974-88 period vis-à-vis its U.S. counterpart, even after taking into account the favourable effect of the depreciation of the Canadian dollar. The large appreciation of the dollar between 1986 and 1991 has further worsened the industry's position. Thus the future of Canada's high-technology exports in

Table A-30

Average annual growth in output, inputs, and TFP in the nonelectrical machinery industry,[1] Canada-U.S. comparisons, 1962-88

	Canada					United States				
	1962-88	1962-73	1974-88	1974-79	1980-88	1962-88	1962-73	1974-88	1974-79	1980-88
	(Average annual per cent change)									
Gross output	5.6	9.3	2.6	5.7	0.6	6.7	7.5	6.0	5.6	6.3
Inputs	5.0	7.7	2.8	4.8	1.5	4.6	5.8	3.6	4.6	2.9
Capital	4.1	4.9	3.4	4.5	2.7	5.5	4.8	6.1	6.3	5.9
Labour	3.1	4.6	1.9	3.9	0.5	1.7	3.6	0.2	2.5	-1.3
Energy	4.5	7.5	2.1	4.5	0.6	3.6	8.2	-0.1	0.0	-0.1
Materials	6.5	11.0	3.0	5.2	1.5	6.3	7.8	5.2	5.5	5.0
Services	6.0	9.2	3.4	6.1	1.6	7.5	9.5	5.8	10.8	2.5
TFP	0.6	1.6	-0.2	0.9	-0.9	2.1	1.7	2.4	1.0	3.4

1 The data for the United States and Canada are not strictly comparable. The U.S. industry includes computers while the Canadian industry does not.
SOURCE Estimates by the authors, based on data from Statistics Canada and the U.S. Department of Labor.

Table A-31

Average annual growth in input productivities and TFP in the nonelectrical products industry,[1] Canada-U.S. comparisons, 1962-88

	Canada					United States				
	1962-88	1962-73	1974-88	1974-79	1980-88	1962-88	1962-73	1974-88	1974-79	1980-88
	(Average annual per cent change)									
TFP	0.6	1.6	–0.2	0.9	–0.9	2.1	1.7	2.4	1.0	3.4
Input productivities										
Capital	1.7	4.3	–0.5	1.2	–1.6	1.3	2.7	0.2	–0.4	0.6
Labour	2.2	4.3	0.6	1.7	–0.2	4.8	3.7	5.7	3.0	7.5
Energy	1.2	2.2	0.5	1.2	–0.1	3.2	–0.5	6.1	5.8	6.3
Materials	–0.8	–1.4	–0.3	0.6	–0.9	0.4	–0.2	0.9	0.1	1.5
Services	–0.4	0.1	–0.9	–0.4	–1.1	–0.2	–1.6	0.9	–4.1	4.2

1 The data for the United States and Canada are not strictly comparable. The U.S. industry includes computers while the Canadian industry does not.
Source Estimates by the authors, based on data from Statistics Canada and the U.S. Department of Labor.

Table A-32

Average annual growth in output price, input prices, and TFP in the nonelectrical machinery industry,[1] Canada-U.S. comparisons, 1962-88

	Canada					United States				
	1962-88	1962-73	1974-88	1974-79	1960-88	1962-88	1962-73	1974-88	1974-79	1960-88
	(Average annual per cent change)									
Gross output price	5.8	2.8	8.3	11.5	6.1	2.4	2.4	2.4	7.5	-1.1
Input prices	6.4	4.4	8.1	12.4	5.2	4.5	4.1	4.8	8.5	2.3
Capital[2]	9.5	6.5	12.0	20.4	8.3	2.5	4.8	0.6	5.5	-2.7
Labour	7.2	6.1	8.0	10.9	8.1	6.7	5.7	7.4	9.5	6.0
Energy	6.6	1.4	10.8	17.3	6.4	6.4	1.5	10.4	17.7	6.6
Materials	5.5	2.5	7.9	12.1	5.0	3.2	2.5	3.7	8.3	0.7
Services	5.5	3.2	7.4	9.4	6.0	5.2	3.5	6.6	7.2	3.2
TFP	0.6	1.6	-0.2	0.9	-0.9	2.1	1.7	2.4	1.0	3.4

1 The data for the United States and Canada are not strictly comparable. The U.S. industry includes computers while the Canadian industry does not.
2 Variations in the price of capital include variations in profit margins.
Source Estimates by the authors, based on data from Statistics Canada and the U.S. Department of Labor.

Table A-33

Average annual growth in output price and input costs in the nonelectrical machinery industry,[1] Canada-U.S. comparisons, 1962-88

	Canada					United States				
	1962-88	1962-73	1974-88	1974-79	1980-88	1962-88	1962-73	1974-88	1974-79	1980-88
	(Average annual per cent change)									
Gross output price	5.8	2.8	8.3	11.5	6.1	2.4	2.4	2.4	7.5	-1.1
Input costs	5.8	2.8	8.3	11.5	6.1	2.4	2.4	2.4	7.5	-1.1
Capital	7.2	1.9	11.4	18.5	6.8	1.5	2.1	1.0	7.0	-3.1
Labour	5.1	1.8	7.7	9.3	6.7	1.9	1.9	1.9	6.4	-1.1
Energy	6.1	0.0	11.0	16.6	7.3	3.7	2.2	4.9	12.0	0.2
Materials	6.3	3.9	8.2	11.6	6.0	2.8	2.7	2.8	8.3	-0.8
Services	6.1	3.2	8.4	10.0	7.3	6.0	5.5	6.4	12.3	2.6

1 The data for the United States and Canada are not strictly comparable. The U.S. industry includes computers while the Canadian industry does not.
Source Estimates by the authors, based on data from Statistics Canada and the U.S. Department of Labor.

this area appears bleak, and the importance of machinery products in world trade makes this a cause for concern. The industry needs to achieve a quite substantial improvement in its productivity and cost performance to overcome this gloomy outlook.

B Input Shares in Total Cost for Canada and the United States

Table B-1
Capital share in total cost (current dollar), Canadian and U.S. industries, 1962-88

	1962-73		1974-79		1980-88		1974-88	
	Canada	United States	Canada	United States	Canada	United States	Canada	United States
	(Per cent)							
Aggregate manufacturing	12.4	10.7	11.0	9.2	11.1	8.9	11.1	9.0
Food and beverages	11.6	6.5	10.6	5.9	12.2	7.3	11.6	6.8
Paper and allied products	16.5	12.9	17.3	11.6	15.4	12.0	16.2	11.8
Primary metal products	11.6	11.0	8.9	9.0	8.8	6.8	8.9	7.6
Wood products	9.6	12.2	10.4	13.6	6.8	10.9	8.2	12.0
Chemicals	18.1	19.1	15.6	14.3	16.3	13.9	16.0	14.1
Nonelectrical machinery[1]	13.1	12.9	12.5	10.9	13.7	8.1	13.2	9.2
Electrical products[1]	13.6	10.0	13.2	8.1	14.8	8.6	14.2	8.4
Transportation equipment	9.4	10.6	7.7	5.3	7.5	4.8	7.6	5.0
Nonmetallic mineral products	19.8	14.1	19.0	11.6	17.1	10.9	17.9	11.2
Fabricated metal products	13.2	8.7	13.0	9.4	12.1	10.2	12.4	9.9
Furniture and fixtures	9.8	8.1	9.8	6.9	11.2	8.8	10.7	8.1
Textiles and clothing	9.7	6.9	9.4	6.8	11.1	7.0	10.4	6.9
Printing and publishing	13.6	11.9	15.2	11.9	16.0	13.2	15.7	12.7
Tobacco	14.5	19.7	16.9	23.8	21.8	33.3	19.8	29.5
Rubber and plastics	12.0	8.5	10.6	7.4	10.6	7.1	10.6	7.2
Petroleum refining	6.8	10.5	2.6	10.5	3.6	6.9	3.2	8.3
Miscellaneous manufacturing	13.3	12.9	11.2	11.1	10.5	9.8	10.8	10.3

Aggregate nonmanufacturing	24.0	..	23.0	..	22.6	..	22.8	..
Agriculture	25.8	..	29.7	..	22.2	..	25.2	..
Fishing	28.8	..	16.4	..	29.3	..	24.1	..
Forestry	11.6	..	9.2	..	11.2	..	10.4	..
Mining	45.8	..	48.8	..	46.8	..	47.6	..
Construction	5.3	..	6.8	..	8.2	..	7.6	..
Transportation, storage, and communications	27.6	..	23.0	..	22.6	..	22.8	..
Utilities	60.9	..	56.8	..	62.4	..	60.2	..
Wholesale and retail trade	17.1	..	13.8	..	14.2	..	14.1	..
Finance, insurance, and real estate	43.3	..	36.0	..	30.4	..	32.6	..
Community, business, and personal services	22.8	..	21.2	..	17.9	..	19.2	..
Aggregate service industries[2]	22.3	..	20.1	..	20.1	..	20.1	..
Aggregate primary industries[3]	31.5	..	36.1	..	34.2	..	35.0	..
Business sector	19.9	..	18.8	..	18.5	..	18.6	..

1 Computers are included with electrical products for Canada, and with nonelectrical machinery for the United States.
2 Includes construction; transportation, storage, and communications; utilities; wholesale and retail trade; finance, insurance, and real estate; and community, business, and personal services.
3 Includes agriculture, fishing, forestry, and mining.
Source Estimates by the authors, based on data from Statistics Canada and the U.S. Department of Labor.

Table B-2

Labour share in total cost (current dollar), Canadian and U.S. industries, 1962-88

	1962-73		1974-79		1980-88		1974-88	
	Canada	United States	Canada	United States	Canada	United States	Canada	United States
	(Per cent)							
Aggregate manufacturing	24.6	28.5	22.5	25.5	21.1	25.4	21.7	25.4
Food and beverages	16.4	16.2	15.6	13.7	15.8	14.5	15.7	14.2
Paper and allied products	25.4	27.2	24.3	24.0	22.8	23.5	23.4	23.7
Primary metal products	21.0	25.9	21.2	24.2	21.7	25.0	21.5	24.7
Wood products	29.4	30.9	29.0	26.2	29.0	26.9	29.0	26.6
Chemicals	23.1	24.2	19.8	20.2	16.3	20.0	17.7	20.1
Nonelectrical machinery[1]	32.2	37.2	30.4	34.6	29.5	34.9	29.8	34.8
Electrical products[1]	32.2	38.1	31.0	37.2	29.2	35.1	29.9	35.9
Transportation equipment	22.8	27.9	20.0	27.5	19.0	28.1	19.4	27.9
Nonmetallic mineral products	28.8	35.4	28.0	33.3	26.9	32.2	27.4	32.7
Fabricated metal products	31.6	34.6	29.7	32.1	28.4	31.3	28.9	31.6
Furniture and fixtures	34.8	37.4	34.4	34.5	32.2	32.5	33.1	33.3
Textiles and clothing	29.3	30.3	30.0	29.6	28.6	28.6	29.2	29.0
Printing and publishing	41.8	40.8	38.3	37.5	35.6	34.9	36.7	35.9
Tobacco	14.4	12.4	15.4	13.9	16.6	14.5	16.1	14.2
Rubber and plastics	31.2	35.8	29.6	31.6	27.7	31.0	28.5	31.2
Petroleum refining	7.4	9.8	4.3	5.7	3.9	5.4	4.1	5.5
Miscellaneous manufacturing	33.6	38.9	30.3	36.2	29.7	37.3	30.0	36.9

Aggregate nonmanufacturing	37.1	..	38.5	..	37.9	..	38.1	..
Agriculture	23.7	..	17.6	..	20.4	..	19.3	..
Fishing	40.9	..	51.3	..	37.0	..	42.7	..
Forestry	42.3	..	40.9	..	35.1	..	37.5	..
Mining	22.3	..	18.3	..	18.7	..	18.5	..
Construction	34.6	..	36.8	..	33.6	..	34.9	..
Transportation, storage, and communications	38.7	..	39.1	..	36.0	..	37.2	..
Utilities	23.2	..	23.5	..	20.0	..	21.4	..
Wholesale and retail trade	52.2	..	57.0	..	54.8	..	55.7	..
Finance, insurance, and real estate	28.7	..	32.5	..	33.8	..	33.3	..
Community, business, and personal services	43.8	..	47.8	..	51.5	..	50.0	..
Aggregate service industries[2]	39.7	..	42.5	..	41.4	..	41.8	..
Aggregate primary industries[3]	25.5	..	20.5	..	21.0	..	20.8	..
Business sector	33.2	..	33.3	..	32.0	..	32.5	..

1 Computers are included with electrical products for Canada, and with nonelectrical machinery for the United States.
2 Includes construction; transportation, storage, and communications; utilities; wholesale and retail trade; finance, insurance, and real estate; and community, business, and personal services.
3 Includes agriculture, fishing, forestry, and mining.
Source Estimates by the authors, based on data from Statistics Canada and the U.S. Department of Labor.

Table B-3

Energy share in total cost (current dollar), Canadian and U.S. industries, 1962-88

	1962-73		1974-79		1980-88		1974-88	
	Canada	United States	Canada	United States	Canada	United States	Canada	United States
	(Per cent)							
Aggregate manufacturing	4.8	1.4	9.4	2.2	11.2	2.5	10.5	2.3
Food and beverages	1.1	0.8	1.2	1.2	1.5	1.7	1.4	1.5
Paper and allied products	5.1	2.9	6.8	5.4	8.2	5.7	7.6	5.6
Primary metal products	5.2	3.1	8.6	4.6	8.3	6.5	8.5	5.7
Wood products	1.9	1.5	2.0	1.5	2.8	1.9	2.5	1.7
Chemicals	6.0	3.2	10.3	5.2	15.0	5.1	13.1	5.1
Nonelectrical machinery[1]	0.8	0.8	0.9	1.0	1.2	1.2	1.1	1.1
Electrical products[1]	0.8	0.7	1.0	1.1	1.2	1.2	1.1	1.2
Transportation equipment	0.7	0.5	0.8	0.8	0.9	1.0	0.8	0.9
Nonmetallic mineral products	4.8	4.5	6.5	6.8	7.2	7.5	6.9	7.2
Fabricated metal products	1.0	1.0	1.2	1.4	1.5	1.9	1.4	1.7
Furniture and fixtures	0.9	0.8	1.0	1.1	1.3	1.3	1.2	1.2
Textiles and clothing	0.9	0.9	1.2	1.6	1.6	2.1	1.5	1.9
Printing and publishing	0.9	0.6	0.9	0.8	1.1	1.0	1.0	0.9
Tobacco	0.4	0.3	0.5	0.7	0.6	0.7	0.6	0.7
Rubber and plastics	1.4	1.3	1.6	2.2	2.0	2.8	1.8	2.6
Petroleum refining	64.8	1.8	82.0	2.0	81.6	2.3	81.8	2.2
Miscellaneous manufacturing	0.9	0.8	1.0	1.0	1.2	1.2	1.1	1.1

Aggregate nonmanufacturing	2.9	..	3.6	..	4.3	..	4.0	..
Agriculture	4.6	..	4.5	..	5.7	..	5.2	..
Fishing	5.8	..	7.4	..	10.6	..	9.3	..
Forestry	3.1	..	3.7	..	4.1	..	3.9	..
Mining	3.6	..	3.9	..	4.6	..	4.3	..
Construction	1.8	..	1.9	..	2.4	..	2.2	..
Transportation, storage, and communications	5.1	..	7.3	..	8.8	..	8.2	..
Utilities	6.2	..	10.1	..	9.2	..	9.5	..
Wholesale and retail trade	2.9	..	3.2	..	3.8	..	3.6	..
Finance, insurance, and real estate	1.6	..	2.4	..	2.9	..	2.7	..
Community, business, and personal services	1.7	..	2.2	..	2.5	..	2.4	..
Aggregate service industries[2]	2.7	..	3.5	..	4.1	..	3.9	..
Aggregate primary industries[3]	4.1	..	4.2	..	5.0	..	4.7	..
Business sector	4.0	..	6.3	..	7.3	..	6.9	..

1 Computers are included with electrical products for Canada, and with nonelectrical machinery for the United States.
2 Includes construction; transportation, storage, and communications; utilities; wholesale and retail trade; finance, insurance, and real estate; and community, business, and personal services.
3 Includes agriculture, fishing, forestry, and mining.
Source Estimates by the authors, based on data from Statistics Canada and the U.S. Department of Labor.

Table B-4

Material share in total cost (current dollar), Canadian and U.S. industries, 1962-88

	1962-73		1974-79		1980-88		1974-88	
	Canada	United States	Canada	United States	Canada	United States	Canada	United States
				(Per cent)				
Aggregate manufacturing	47.1	54.3	46.5	57.6	45.5	55.9	45.9	56.6
Food and beverages	60.3	72.0	63.0	75.2	60.1	70.2	61.3	72.2
Paper and allied products	42.0	53.0	41.2	54.7	42.3	53.6	41.9	54.1
Primary metal products	51.6	56.5	50.1	58.8	50.7	56.9	50.5	57.7
Wood products	48.6	52.8	47.8	55.6	49.2	56.1	48.6	55.9
Chemicals	36.5	44.7	38.6	51.0	37.7	49.5	38.0	50.1
Nonelectrical machinery[1]	43.3	44.6	45.0	48.2	44.7	48.1	44.8	48.1
Electrical products[1]	42.6	45.4	43.7	45.8	43.2	43.8	43.4	44.6
Transportation equipment	57.8	57.3	61.2	62.0	62.3	60.8	61.8	61.3
Nonmetallic mineral products	31.8	40.4	32.7	42.1	34.3	42.2	33.7	42.1
Fabricated metal products	43.7	50.7	45.7	52.0	46.9	50.2	46.4	50.9
Furniture and fixtures	41.9	47.7	41.3	49.2	40.7	47.1	41.0	48.0
Textiles and clothing	50.2	58.1	49.5	57.1	48.0	55.5	48.6	56.2
Printing and publishing	29.4	36.2	31.6	37.4	33.2	37.1	32.6	37.2
Tobacco	61.1	61.6	56.9	54.7	49.9	42.2	52.7	47.2
Rubber and plastics	43.9	49.5	46.9	53.2	47.3	52.6	47.1	52.8
Petroleum refining	8.2	72.1	4.4	78.5	4.3	82.1	4.3	80.7
Miscellaneous manufacturing	38.9	40.9	43.5	43.1	43.4	41.1	43.4	41.9

Aggregate nonmanufacturing	20.6	..	18.4	..	17.0	..	17.5	..
Agriculture	38.6	..	39.8	..	41.3	..	40.7	..
Fishing	17.1	..	17.8	..	15.9	..	16.7	..
Forestry	21.8	..	23.7	..	28.2	..	26.4	..
Mining	15.2	..	15.4	..	14.6	..	14.9	..
Construction	43.6	..	38.3	..	38.9	..	38.7	..
Transportation, storage, and communications	10.4	..	10.0	..	10.4	..	10.2	..
Utilities	5.8	..	5.2	..	4.5	..	4.8	..
Wholesale and retail trade	11.1	..	8.7	..	7.6	..	8.1	..
Finance, insurance, and real estate	7.9	..	7.0	..	7.3	..	7.2	..
Community, business, and personal services	15.9	..	12.7	..	10.8	..	11.5	..
Aggregate service industries[2]	19.2	..	16.5	..	15.1	..	15.7	..
Aggregate primary industries[3]	26.9	..	27.2	..	25.9	..	26.5	..
Business sector	29.1	..	27.0	..	26.6	..	26.7	..

1 Computers are included with electrical products for Canada, and with nonelectrical machinery for the United States.
2 Includes construction; transportation, storage, and communications; utilities; wholesale and retail trade; finance, insurance, and real estate; and community, business, and personal services.
3 Includes agriculture, fishing, forestry, and mining.
Source Estimates by the authors, based on data from Statistics Canada and the U.S. Department of Labor.

Table B-5

Services share in total cost (current dollar), Canadian and U.S. Industries, 1962-88

	1962-73		1974-79		1980-88		1974-88	
	Canada	United States	Canada	United States	Canada	United States	Canada	United States
	(Per cent)							
Aggregate manufacturing	11.2	5.1	10.7	5.5	11.0	7.3	10.9	6.6
Food and beverages	10.6	4.5	9.6	4.0	10.3	6.3	10.0	5.4
Paper and allied products	11.0	4.0	10.4	4.3	11.2	5.1	10.9	4.8
Primary metal products	10.5	3.5	11.1	3.4	10.4	4.9	10.7	4.3
Wood products	10.5	2.7	10.8	3.1	12.3	4.2	11.7	3.8
Chemicals	16.4	8.8	15.7	9.3	14.7	11.5	15.1	10.6
Nonelectrical machinery[1]	10.6	4.5	11.2	5.3	10.9	7.6	11.1	6.7
Electrical products[1]	10.9	5.7	11.1	7.8	11.5	11.3	11.4	9.9
Transportation equipment	9.3	3.7	10.3	4.4	10.4	5.2	10.4	4.9
Nonmetallic mineral products	14.8	5.7	13.8	6.2	14.5	7.3	14.2	6.8
Fabricated metal products	10.4	5.1	10.5	5.2	11.0	6.4	10.8	5.9
Furniture and fixtures	12.6	6.0	13.5	8.3	14.5	10.3	14.1	9.5
Textiles and clothing	9.9	3.8	9.8	4.9	10.7	6.7	10.4	6.0
Printing and publishing	14.3	10.5	13.9	12.3	14.1	13.8	14.0	13.2
Tobacco	9.7	6.0	10.3	7.0	11.0	9.3	10.7	8.4
Rubber and plastics	11.6	5.0	11.4	5.6	12.4	6.6	12.0	6.2
Petroleum refining	12.8	5.8	6.7	3.2	6.6	3.3	6.7	3.3
Miscellaneous manufacturing	13.2	6.6	14.0	8.6	15.2	10.6	14.7	9.8

Aggregate nonmanufacturing	15.3	..	16.5	..	18.3	..	17.6	..
Agriculture	9.3	..	8.4	..	10.3	..	9.6	..
Fishing	7.4	..	7.1	..	7.2	..	7.2	..
Forestry	21.4	..	22.4	..	21.4	..	21.8	..
Mining	13.3	..	13.6	..	15.4	..	14.7	..
Construction	14.7	..	16.1	..	17.0	..	16.6	..
Transportation, storage, and communications	18.1	..	20.6	..	22.3	..	21.6	..
Utilities	4.0	..	4.4	..	3.9	..	4.1	..
Wholesale and retail trade	16.7	..	17.2	..	19.6	..	18.6	..
Finance, insurance, and real estate	18.5	..	22.1	..	25.6	..	24.2	..
Community, business, and personal services	15.9	..	16.2	..	17.3	..	16.8	..
Aggregate service industries[2]	16.1	..	17.5	..	19.2	..	18.5	..
Aggregate primary industries[3]	12.0	..	11.9	..	13.8	..	13.0	..
Business sector	13.9	..	14.5	..	15.7	..	15.2	..

1 Computers are included with electrical products for Canada, and with nonelectrical machinery for the United States.
2 Includes construction; transportation, storage, and communications; utilities; wholesale and retail trade; finance, insurance, and real estate; and community, business, and personal services.
3 Includes agriculture, fishing, forestry, and mining.
Source Estimates by the authors, based on data from Statistics Canada and the U.S. Department of Labor.

Notes

1 Star [1974] has shown that

$$\dot{TFP} = \beta \dot{TFP}^{*}$$

where *TFP* and *TFP** are estimates of total factor productivity growth based on gross and net output respectively, and β is the share of primary inputs (capital and labour) in gross output.

2 The importance of such shifts for total factor productivity growth is obvious. For instance, a shift in capital and labour inputs from low productivity to high productivity sectors, other things remaining unchanged, will increase the aggregate productivity growth rate.

3 We used employment data as the basis for our input in the computation of Canadian TFP because of the lack of reliable hours data at the industry level. The input of services from capital is based on geometrically depreciated year-end net capital stock data (capital is assumed to depreciate at the same rate every year). Regarding the data on the U.S. manufacturing industries, see Gullickson and Harper [1986].

4 It should be noted that the average input shares shown in Appendix B, cannot be used to compute the average changes in TFP and total unit costs over a given time period. This is because TFP and total unit cost are derived here by first aggregating the input components for each year in a given time period and then averaging over the whole time period.

5 Of course, one could argue that the slowdown in TFP growth itself might be caused by the drop in output growth. Theoretically, the causation runs both ways. But over the medium term, it is more likely that the causation runs from TFP growth to output growth. In another paper [Rao and Lemprière 1992*a*] we explain the trends in TFP, labour productivity, and output growth by industry in terms of a common set of supply and demand side factors.

6 Output growth depends on TFP growth and input growth ($\dot{I}$):

$$\dot{Q} = F(\dot{TFP}, \dot{I})$$

But, input growth itself depends on demand (output) growth, and the growth in input prices relative to the output price

$$\dot{I} = I[\dot{Q}, (\dot{P_I}/\dot{P_Q})].$$

Therefore, in the long run, output growth of an industry mainly depends on TFP growth:

$$\dot{Q} = H\,[\dot{TFP},\ (P_I/\dot{P}_Q)].$$

7 By regressing the average annual per cent change in the gross output price of the U.S. and Canadian manufacturing industries on their average TFP growth rates for the post-1973 period, we obtained the following equation:

$$\dot{P}_Q = 8.3 - 2.0\,\dot{TFP} \qquad \bar{R}^2 = 0.39,\ \text{D.W.} = 1.6$$
$$(22.4)\,(4.7)$$

This equation implies that a one-percentage-point increase in the TFP growth rate reduces the manufacturing sector's price growth by 2.0 percentage points. This result strongly suggests that the observed changes in relative prices among the Canadian and U.S. manufacturing industries during the 1974-88 period could largely be explained in terms of the variations in TFP growth rates among them during their period.

8 Regressing the change in output growth between the two periods (1974-88 and 1962-73) on the change in TFP growth across the Canadian manufacturing industries gives the following equation:

$$\Delta\dot{Q} = -1.6 + 2.2\,\Delta\dot{TFP} \qquad \bar{R}^2 = 0.42,\ \text{D.W.} = 2.4$$
$$(2.0)\ (3.5)$$

This implies that a one-percentage-point increase in the manufacturing sector's TFP growth will directly and indirectly increase its output growth rate by 2.2 percentage points. This result, in turn, implies that the post-1973 TFP slowdown in Canadian manufacturing contributed almost 75 per cent to the slowdown in its output growth.

9 The rationale for this calculation is straightforward. It follows from the relative unit total costs identity:

$$\frac{UTC^{*Can}}{UTC^{*US}} = \frac{UTC^{Can}}{UTC^{US}}\,ER$$

where UTC^{*Can} and UTC^{*US} are unit total costs in Canada and the United States expressed in a common currency, UTC^{Can} and UTC^{US} are unit total costs in the national currencies and ER is the exchange rate (US$/CAN$). The corresponding growth relationship is

$$(\dot{UTC}^{*Can} - \dot{UTC}^{*US}) = (\dot{UTC}^{Can} - \dot{UTC}^{US}) + \dot{ER}$$

Thus if the growth in Canadian relative unit costs (measured in national currency) exceeds the rate of depreciation of the Canadian dollar, then Canada's competitive position will deteriorate, and vice versa.

10 A detailed comparison of labour productivity levels in Canada, the United States, and other major countries is provided in Rao and Lemprière [1992*a*].

11 The puzzle of falling productivity in the U.S. construction industry since 1967 was examined in detail by Baily and Gordon (1988). They argued that the declining productivity is largely due to errors in measuring U.S. construction output, arising from some combination of three problems: undercounting nominal new construction, overstatement of construction deflator, and overcounting of material inputs that are subtracted from the value of construction output in calculating the value-added of the industry. However, their arguments have been questioned and the declining construction productivity remains a mystery.

List of Tables and Figures

Tables

1	Average annual growth in gross output (constant prices) and total factor productivity, Canadian industries, 1962-88	11
2	Average annual growth in aggregate input price and total unit costs, Canadian industries, 1962-88	14
3	Sources of real output growth in the Canadian business sector, 1962-88	16
4	Average annual growth in total factor productivity, Canadian and U.S. manufacturing industries, 1962-88	18
5	Average annual growth in total unit costs, Canadian and U.S. manufacturing industries, 1962-88	21
6	Average annual growth in output, inputs, and TFP in manufacturing, Canada and the United States, 1962-88	23
7	Average annual growth in input productivities and TFP in manufacturing, Canada and the United States, 1962-88	24
8	Average annual growth in output prices, input price, and TFP in manufacturing, Canada and the United States, 1962-88	25
9	Average annual growth in output price and input costs in manufacturing, Canada and the United States, 1962-88	26
10A	Average annual growth in output, inputs, and TFP in nonmanufacturing, Canada, 1962-88	29
10B	Average annual growth in input productivities and TFP in nonmanufacturing, Canada, 1962-88	29
11A	Average annual growth in output price, input prices, and TFP in nonmanufacturing, Canada, 1962-88	30
11B	Average annual growth in output price and input costs in nonmanufacturing, Canada, 1962-88	30
12A	Average annual growth in output, inputs, and TFP in agriculture, Canada, 1962-88	31
12B	Average annual growth in input productivities and TFP in agriculture, Canada, 1962-88	31
13A	Average annual growth in output, inputs, and TFP in forestry, Canada, 1962-88	32
13B	Average annual growth in input productivities and TFP in forestry, Canada, 1962-88	32
14A	Average annual growth in output, inputs, and TFP in fishing, Canada, 1962-88	33
14B	Average annual growth in input productivities and TFP in fishing, Canada, 1962-88	33

15A Average annual growth in output, inputs, and TFP in mining, Canada, 1962-88 34
15B Average annual growth in input productivities and TFP in mining, Canada, 1962-88 34
16A Average annual growth in output, inputs, and TFP in construction, Canada, 1962-88 36
16B Average annual growth in input productivities and TFP in construction, Canada, 1962-88 36
17A Average annual growth in output, inputs, and TFP in the utility industry, Canada, 1962-88 37
17B Average annual growth in input productivities and TFP in the utility industry, Canada, 1962-88 37
18A Average annual growth in output, inputs, and TFP in the transportation, storage, and communications industry, Canada, 1962-88 38
18B Average annual growth in input productivities and TFP in the transportation, storage, and communications industry, Canada, 1962-88 38
19A Average annual growth in output, inputs, and TFP in the wholesale and retail trade industry, Canada, 1962-88 39
19B Average annual growth in input productivities and TFP in the wholesale and retail trade industry, Canada, 1962-88 39
20A Average annual growth in output, inputs, and TFP in the finance, insurance, and real estate industry, Canada, 1962-88 40
20B Average annual growth in input productivities and TFP in the finance, insurance, and real estate industry, Canada, 1962-88 40
21A Average annual growth in output, inputs, and TFP in the community, business, and personal services industry, Canada, 1962-88 41
21B Average annual growth in input productivities and TFP in the community, business, and personal services industry, Canada, 1962-88 41
22 Annual growth in labour productivity, nonmanufacturing industries, Canada and the United States, 1962-86 42
23 Annual growth in unit labour costs, nonmanufacturing industries, Canada and the United States, 1962-86 44
24 Annual growth in the value-added deflator, nonmanufacturing industries, Canada and the United States, 1962-86 46
25 Average annual growth in the energy/output ratio, total factor productivity, and total unit costs, Canadian business-sector industries, 1974-88 50
26 Average annual growth in the energy/output ratio, total factor productivity, and total unit costs, United States manufacturing industries, 1974-88 51

A-1 Indicators of the importance of the eight major Canadian manufacturing industries, 1988 55
A-2 Average annual growth in output, inputs, and TFP in the food and beverage industry, Canada-U.S. comparisons, 1962-88 57
A-3 Average annual growth in input productivities and TFP in the food and beverage industry, Canada-U.S. comparisons, 1962-88 58
A-4 Average annual growth in output price, input prices, and TFP in the food and beverage industry, Canada-U.S. comparisons, 1962-88 60
A-5 Average annual growth in output price and input costs in the food and beverage industry, Canada-U.S. comparisons, 1962-88 61
A-6 Average annual growth in output, inputs, and TFP in the paper and allied products industry, Canada-U.S. comparisons, 1962-88 62
A-7 Average annual growth in input productivities and TFP in the paper and allied products industry, Canada-U.S. comparisons, 1962-88 63
A-8 Average annual growth in output price, input prices, and TFP in the paper and allied products industry, Canada-U.S. comparisons, 1962-88 64
A-9 Average annual growth in output price and input costs in the paper and allied products industry, Canada-U.S. comparisons, 1962-88 65
A-10 Average annual growth in output, inputs, and TFP in the primary metal products industry, Canada-U.S. comparisons, 1962-88 67
A-11 Average annual growth in input productivities and TFP in the primary metal products industry, Canada-U.S. comparisons, 1962-88 68
A-12 Average annual growth in output price, input prices, and TFP in the primary metal products industry, Canada-U.S. comparisons, 1962-88 69
A-13 Average annual growth in output price and input costs in the primary metal products industry, Canada-U.S. comparisons, 1962-88 70
A-14 Average annual growth in output, inputs, and TFP in the wood industry, Canada-U.S. comparisons, 1962-88 72
A-15 Average annual growth in input productivities and TFP in the wood industry, Canada-U.S. comparisons, 1962-88 73
A-16 Average annual growth in output price, input prices, and TFP in the wood industry, Canada-U.S. comparisons, 1962-88 74

A-17 Average annual growth in output price and input costs in the wood industry, Canada-U.S. comparisons, 1962-88 75
A-18 Average annual growth in output, inputs, and TFP in the transportation equipment industry, Canada-U.S. comparisons, 1962-88 77
A-19 Average annual growth in input productivities and TFP in the transportation equipment industry, Canada-U.S. comparisons, 1962-88 78
A-20 Average annual growth in output price, input prices, and TFP in the transportation equipment industry, Canada-U.S. comparisons, 1962-88 79
A-21 Average annual growth in output price and input costs in the transportation equipment industry, Canada-U.S. comparisons, 1962-88 81
A-22 Average annual growth in output, inputs, and TFP in the chemical and chemical products industry, Canada-U.S. comparisons, 1962-88 82
A-23 Average annual growth in input productivities and TFP in the chemical and chemical products industry, Canada-U.S. comparisons, 1962-88 83
A-24 Average annual growth in output price, input prices, and TFP in the chemical and chemical products industry, Canada-U.S. comparisons, 1962-88 85
A-25 Average annual growth in output price and input costs in the chemical and chemical products industry, Canada-U.S. comparisons, 1962-88 86
A-26 Average annual growth in output, inputs, and TFP in the electrical products industry, Canada-U.S. comparisons, 1962-88 87
A-27 Average annual growth in input productivities and TFP in the electrical products industry, Canada-U.S. comparisons, 1962-88 88
A-28 Average annual growth in output price, input prices, and TFP in the electrical products industry, Canada-U.S. comparisons, 1962-88 90
A-29 Average annual growth in output price and input costs in the electrical products industry, Canada-U.S. comparisons, 1962-88 91
A-30 Average annual growth in output, inputs, and TFP in the nonelectrical machinery industry, Canada-U.S. comparisons, 1962-88 93
A-31 Average annual growth in input productivities and TFP in the nonelectrical products industry, Canada-U.S. comparisons, 1962-88 94

A-32 Average annual growth in output price, input prices, and TFP in the nonelectrical machinery industry, Canada-U.S. comparisons, 1962-88 95
A-33 Average annual growth in output price and input costs in the nonelectrical machinery industry, Canada-U.S. comparisons, 1962-88 96
B-1 Capital share in total cost (current dollar), Canadian and U.S. industries, 1962-88 98
B-2 Labour share in total cost (current dollar), Canadian and U.S. industries, 1962-88 100
B-3 Energy share in total cost (current dollar), Canadian and U.S. industries, 1962-88 102
B-4 Material share in total cost (current dollar), Canadian and U.S. industries, 1962-88 104
B-5 Services share in total cost (current dollar), Canadian and U.S. industries, 1962-88 106

Figures

1 Sources of growth in business-sector real GDP, Canada, 1962-88 10
2 Sources of growth in nonmanufacturing real gross output, Canada, 1962-88 12
3 Sources of growth in manufacturing real gross output, Canada, 1962-88 13
4 Growth in manufacturing total factor productivity, Canada and the United States, 1962-88 19
5 Growth in manufacturing total unit costs, Canada and the United States, 1962-88 20
6 Growth in labour productivity, nonmanufacturing industries, Canada and the United States, 1962-86 35
7 Canadian real energy prices and energy/output ratio, manufacturing, 1961-88 52
8 United States real energy prices and energy/output ratio, manufacturing, 1961-88 52

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